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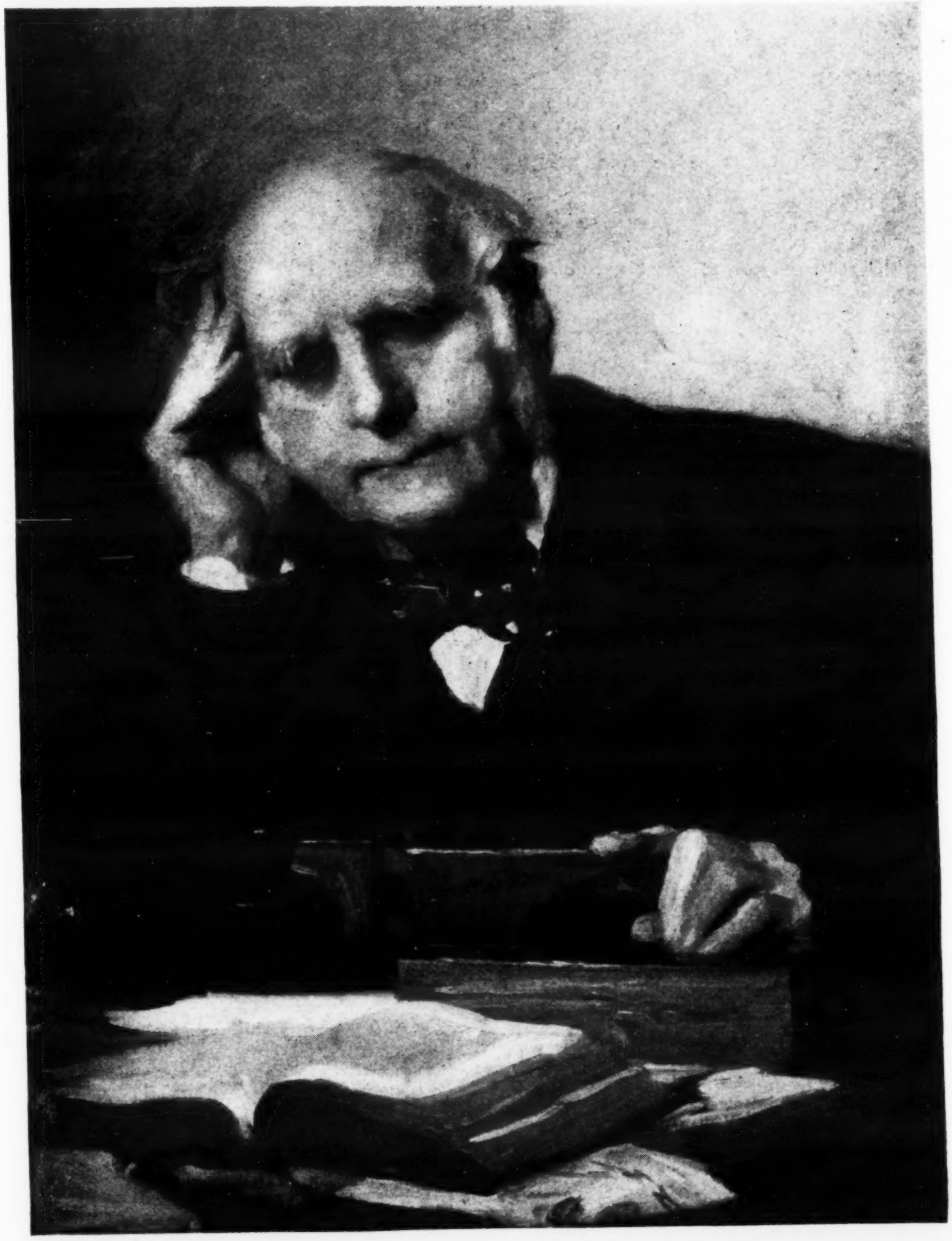

Francis Galton

VOLUME 21 FEBRUARY, 1930 NUMBER 2

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Human Heredity

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Semi-Lethal Mutations in Datura

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"Earless" Karakul Sheep

Not really lacking ears, but with ears reduced to stubs by a mendelizing gene.

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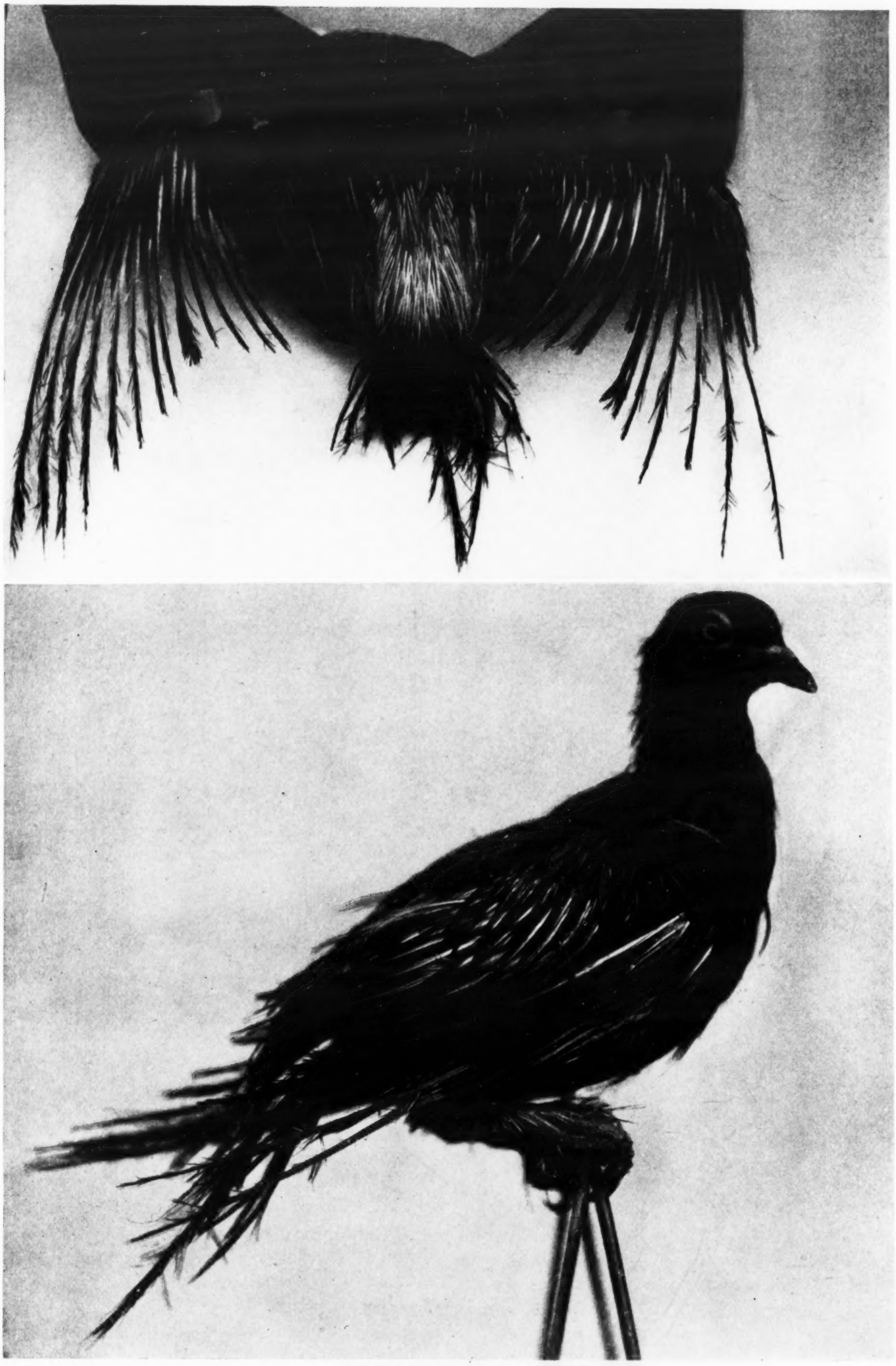


A PIGEON WITH QUILLS

Frontispiece

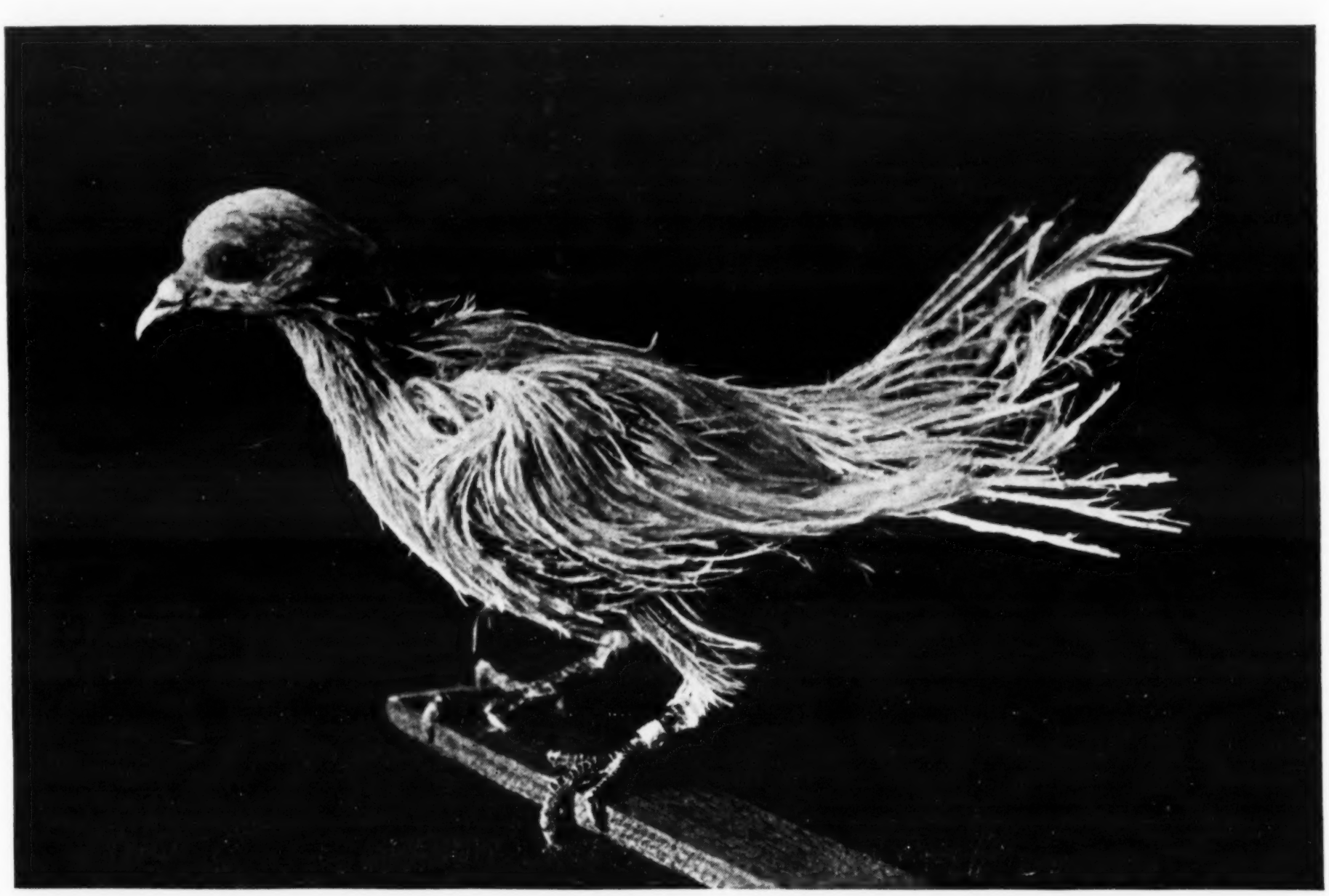
Dorsal and side view of "Porcupine" 2406F, at four months of age. When the feathers first come out the imperfect web expands to a certain extent. This soon wears off leaving little except the quills. The porcupine character appears to be a simple recessive.

"PORCUPINE" PIGEONS*

Studies on Inheritance in Pigeons—VIII

L. J. Cole and L. E. Hawkins

University of Wisconsin



THE ORIGINAL "PORCUPINE"

Figure 1

White Fantail "Porcupine" male, 1357B, received in 1913 from Prof. Frank Smith of the University of Illinois. This strain died out before it was possible to make an analysis of the character. Not until thirteen years later was the character found again, this time in a strain of Homer pigeons.

IN May, 1913, Professor Frank Smith of the University of Illinois sent to this department five white Fantail pigeons, a pair and three of their young. The plumage and general appearance of the two parent birds were entirely normal for Fantails, as was true also of two of the three offspring. The third young bird, however, while a white Fantail in other respects, had plumage which was strikingly abnormal. In gross appearance this consisted of an almost complete lack of the web of the feathers, as a consequence of which the bird appeared to be covered with quills (Figures 1 and 2). This quilled or spiny appearance naturally suggested the name "Porcupine" for the abnormality. The actual structure of the feathers will be described further on.

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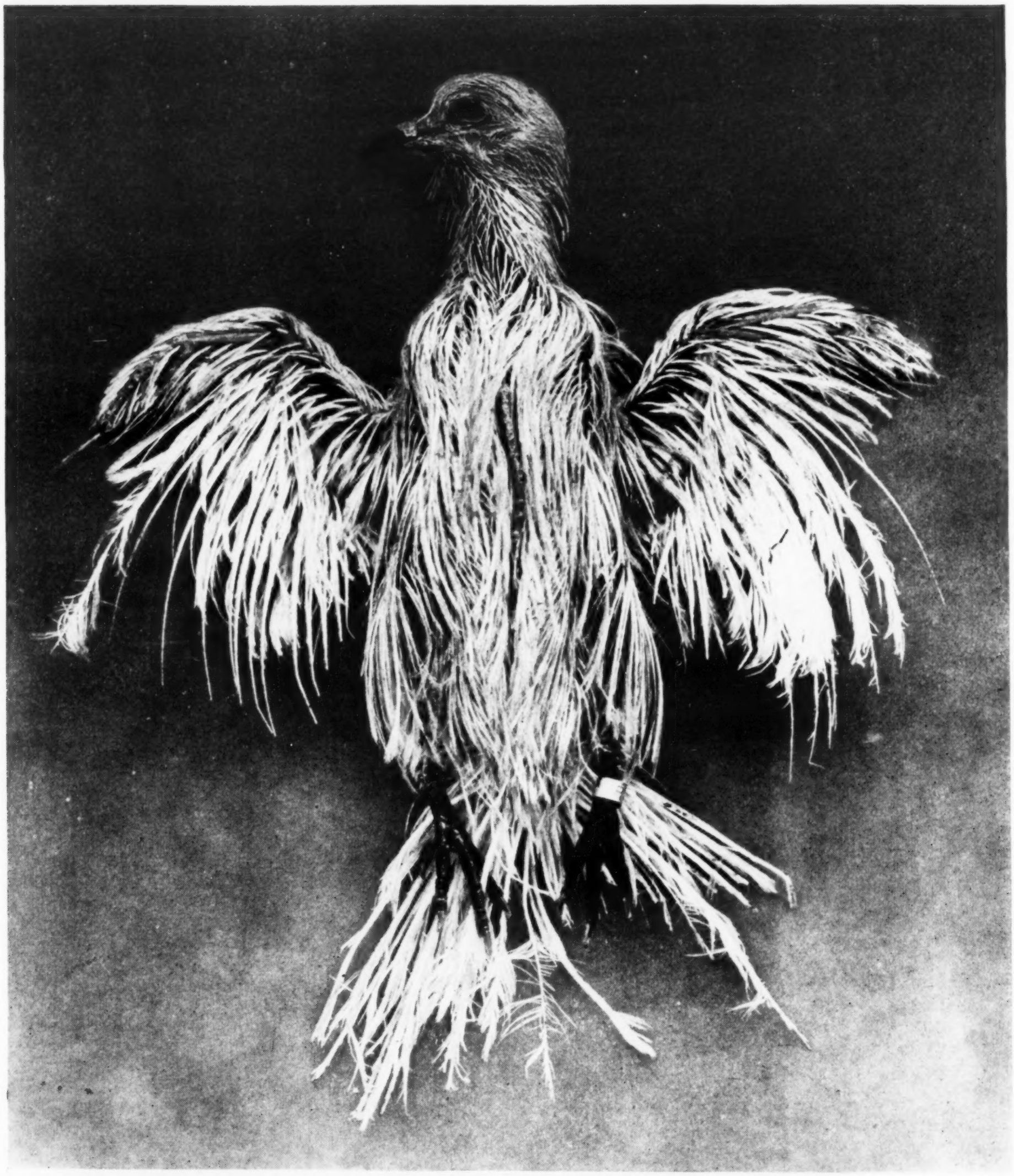
*Papers from the Department of Genetics, Agricultural Experiment Station, University of Wisconsin, No. 103. Published with the approval of the Director of the Station. The writers wish to express their appreciation of the interest and generosity of Professor Frank Smith, of the University of Illinois, and Mr. G. W. Drives, of Madison, in donating the pigeons which contributed the foundation stock for this study.



FEATHER DEVELOPMENT IN A MATURE "PORCUPINE"

Figure 2

Ventral view of the Original Porcupine 1357B, shown in Figure 1. Obviously "Porcupines" cannot fly with such a limited feather development.

An attempt to propagate the strain in order to study the inheritance of the defect was unsuccessful. This mutant, which was numbered 1357B, was a vigorous male and was mated with a normal female. He appeared to be unable to copulate successfully, however, probably because not able to use his wings in the process, and all the eggs produced were infertile. Professor Smith had previously had a similar result from a male porcupine mated to a normal female. In a letter he further stated: "No freak has lain eggs and in fact I am not dead sure that I have had a female. One that I supposed was a female died in my absence in 1910. The two that I preserved were males and one that died in 1910 was too young to have indicated sex by its actions."

The original pair raised only one squab to feathering while in our possession. This was a Porcupine, and a male, but died before breeding age. The production of this pair, as completely as known, may be summarized as follows:

1909 (before obtained by Prof. Smith), 3 Porcupines, 3 normals (said to be one of each in three broods).
1910 (in Prof. Smith's possession), 1 Porcupine, no normals.
1911 (in Prof. Smith's possession), 2 Porcupines, 1 normal.
1913 (at Wisconsin), 1 Porcupine.
Total, 7 Porcupines, 4 normals.

The three Porcupines whose sex was determined were all males, which was considered as possibly significant at the time. Prof. Smith states of the freaks raised by him that "all were more or less unsteady on their legs," and it was recorded on August 18, 1913, of the one raised at Wisconsin, that "when undisturbed in a large pen frequently shows a rotary movement resembling very much those performed by waltzing mice but slower." These facts are cited as possibly indicating that the abnormality may have had a more deep-seated effect than on the plumage alone.

The attempt was next made to perpetuate the trait by outcrossing the original normal parents to unrelated normal stock. The male (1355A) mated to a young Tumbler female produced seven young typical of Fantail crosses* and all with normal plumage. The female (1356A) was mated to a blue Homer and produced three normal offspring. These young were next intermated and the inbreeding carried on for several years, but the Porcupine character did not reappear. Even though it is a simple recessive, this result is not particularly surprising considering the limited number of matings that could be made and the small number of offspring, as a rule, from any one mating.

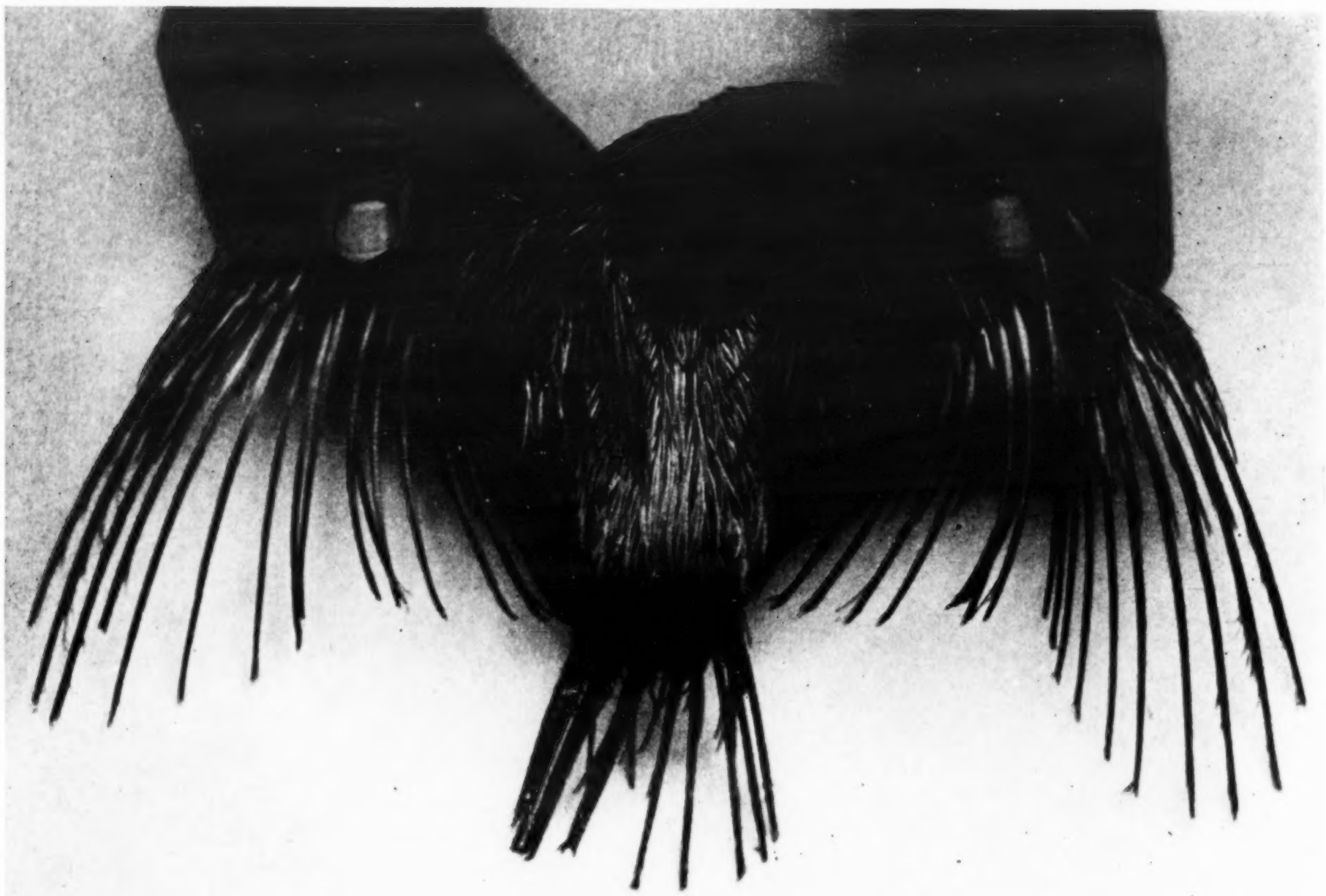
Porcupines From A New Source

Not until 1927, after a lapse of thirteen years, did the Porcupine character again come to our attention. Early in that year a local pigeon breeder, Mr. G. W. Drives, brought to us three birds with the characteristic condition. These were a male and two females which had been produced in his loft by a pair of normal Homers. Further than this, nothing was known of their ancestry. The character of plumage in these three birds was quite the same as that of the Fantail Porcupines, being, if any different, a bit further from the normal. It was found possible to mate these female Porcupines successfully with normal males of our own stock and by carrying the breeding on into successive generations it has been possible to make what we believe to be an adequate analysis of the inheritance of the character.

Description of the Character

The appearance of Porcupine in the Homer stock is illustrated by the frontispiece and Figure 3. Figure 3 is a photograph of a one-month-old squab, 2309W_2, just before obtaining full growth of its plumage; the Frontispiece is of 2406F at four months of age and shows clearly the ragged ap-

*The inheritance of the number of tail feathers and of the uropygial gland in these crosses has been discussed by Johansson.[3]



A ONE-MONTH-OLD SQUAB

Figure 3

"Porcupine" 2309W_2, showing feather development in a young bird. Later feathers tend to have a more extensive web, but they never approach the normal condition.

pearance of what there is of the web or vane of the feather.

Figure 4 represents the appearance of a Porcupine feather under the microscope. This should be compared with Figure 5, showing a similar view of the tip of a normal feather. The Porcupine character is unmistakable from the time of the first appearance of the tip of the feather beyond the feather sheath in the young squab. The normal feather spreads out into more or less of a fan-shape immediately as it emerges from the sheath, the central shaft, barbs, barbules, and hooks all being clearly identified. The Porcupine feather fails to spread out as it passes the sheath, but remains rolled like that portion of the normal feather within the sheath. Under the microscope the feather seems to possess most of its essential parts, but they are not all clearly differentiated. The central shaft is present, some barbs and barbules may be seen, and even a few hooks on the barbules are visible. The barbs fail to separate clearly from one another, however, leaving an irregular lattice-work appearance, composed of anastomosing trabeculae, the longitudinal splits indicating an abortive attempt at differentiation. The barbules are largely massed together also, few of them attaining their normal structure. The general appearance suggests that development has been arrested while the feather was rolled up in the sheath more or less as a rolled sheet or scroll, at a time when differentiation of the barbs and barbules had begun but was not complete.

As the feather elongates, it mostly retains its rolled condition, causing the resemblance to a long spine or quill, as shown in Figure 3. After a time, the barbs, still massed together, unfold somewhat but never become normal.

The entire feather, and especially the portion outside the central shaft, is very brittle, and soon becomes worn and ragged, often leaving only the quill or rachis of the feather exposed. As the birds grow older the plumage tends to be a trifle nearer normal when it first opens out (Frontispiece), but it never at all closely approximates the normal condition. Certain feathers of the juvenile plumage of Porcupine squabs were plucked; those replacing them later were typically Porcupine. There is a slight variation among the Porcupines, but there is never any real intermediate between them and the normal. None of them can fly, although they seem quite active and healthy otherwise. Their viability is essentially the same as that of normals of the same strain, but the Porcupine females have for the most part been poor layers. One of the original Drives females (2265A) developed an abnormal behavior that was at first thought possibly to be associated with the feather defect, but the breeding results have given no evidence of its being heritable. This bird was received from Mr. Drives in December, 1926, and laid fairly regularly from January to May, 1927. It later developed the habit of carrying its head bent around underneath its body (Figure 6) and sometimes sitting on it this way for hours at a time. More than once the bird was thought to be dead, but when aroused it appeared to be all right except for this peculiar posture and nervous movements generally. In some respects it seemed to resemble the condition described by Riddle[4] as ataxia, but it is doubtful that it is the same.* The bird lived in this state until August, 1928. Cause of death at that time was not determined.

It has been very difficult to secure productive matings of Porcupine with Porcupine, probably due to lack of ability on the part of the male to balance himself in the mating act. There has been one such mating, however, which has given fertility. No mating of Porcupine male with normal female has been secured.

Breeding Results

All matings made in studying this character were completely controlled so that there is no possibility of mistake in the parentage of any of the progeny represented in Table I. Part *a* of the table is a mating of a blue Homer pigeon, 1953E, with normal plumage, with a red Porcupine, 2265A, one of the three received from Mr. Drives. From this mating were raised seven young, which lived until well feathered. All of them had normal plumage. Two of these F_1 normals, 2267N and 2267J, were paired together in mating 2309 (Table I, *b*). They produced seventeen normal and eight Porcupine offspring. Mating 2371 is of two birds of normal plumage, 2318B and 2313L, whose mothers were Porcupine and whose fathers were normal F_1's from the original mating, 2267. Thus, mating 2371 is like 2309. From it were produced five normals and three Porcupines. These two matings together produced twice as many normals as Porcupines.

The next two matings (Table I, *c*) are of F_1 normal males with unrelated normal females, 2267F and 2271G, and 2267R with 1944B. From them were produced six offspring, none of which was Porcupine.

The backcross of normal F_1 to Porcupine is represented in matings 2313, 2318, 2355, and 2405, shown in part *d* of the table. The birds paired in these four matings are 2267M with 2265C, an original Porcupine; 2267F with his mother, 2265A; later, 2267F with 2309K, an F_2 Porcupine segregate; and 2267M with one of his Porcupine daughters, 2313G. Twenty-four squabs were produced from these matings, fourteen of which were normal and ten Porcupine.

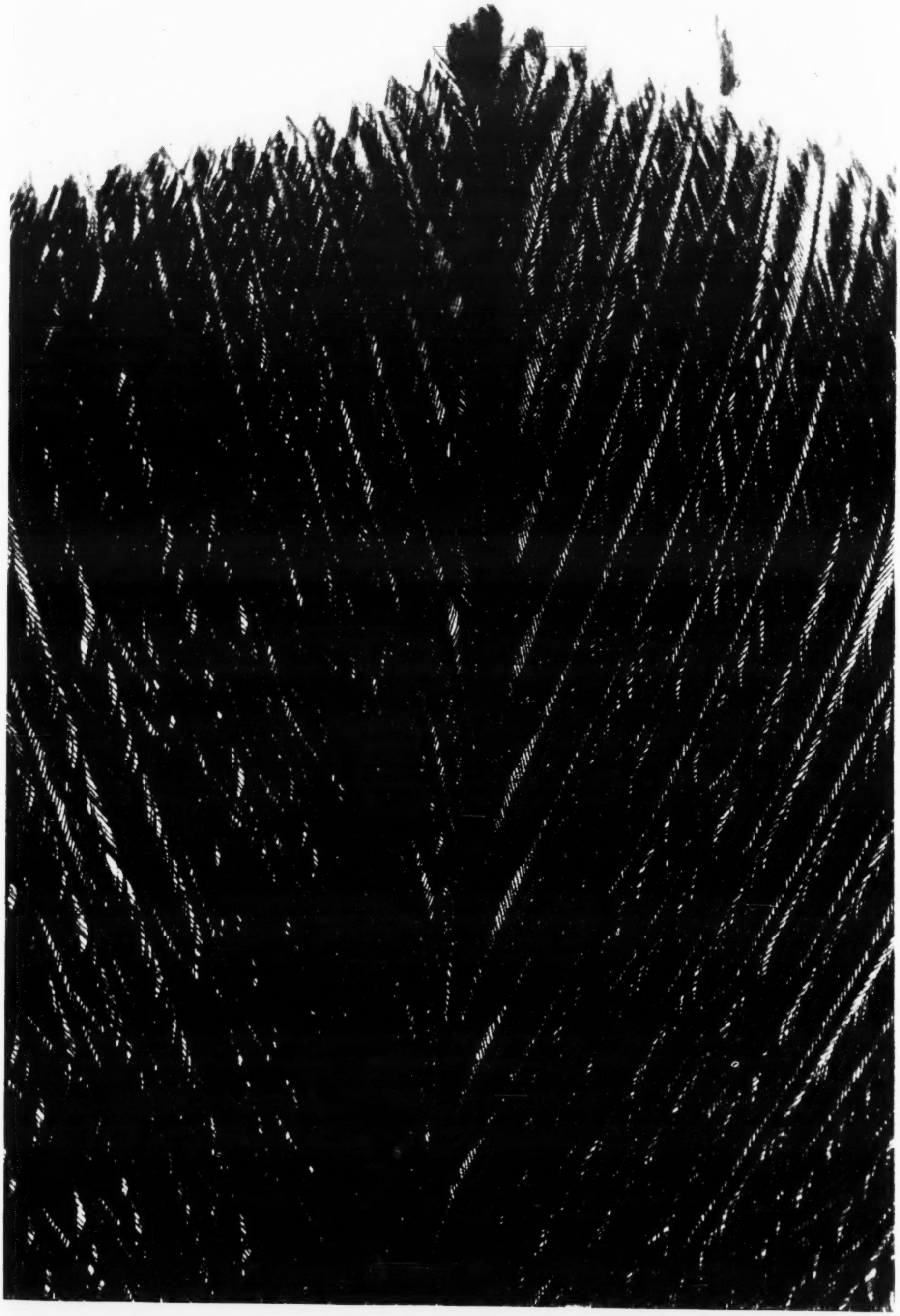
The last mating, 2406, is of two Porcupine F_2's from the F_1 mating, 2309.

*Subsequent examination of Riddle's birds shows his "ataxia" to be quite different.—*L. J. C.*

A "PORCUPINE" FEATHER ENLARGED

Figure 4

Magnified tip of primary feather from "Porcupine" 2309W_2 (shown in Fig. 3). Owing to irregular formation of the feather parts there is a lattice-work effect. This is very friable, wearing away and often leaving little but the bare quill. The curled condition of the feather makes it impossible to get all parts into focus at one time, as in the case of the normal feather (Figure 5).



A NORMAL FEATHER

Figure 5

Magnified tip of a normal primary feather. Note the regular formation of barbs and barbules.

POSTURE DEFECT OF A "PORCUPINE"

Figure 6

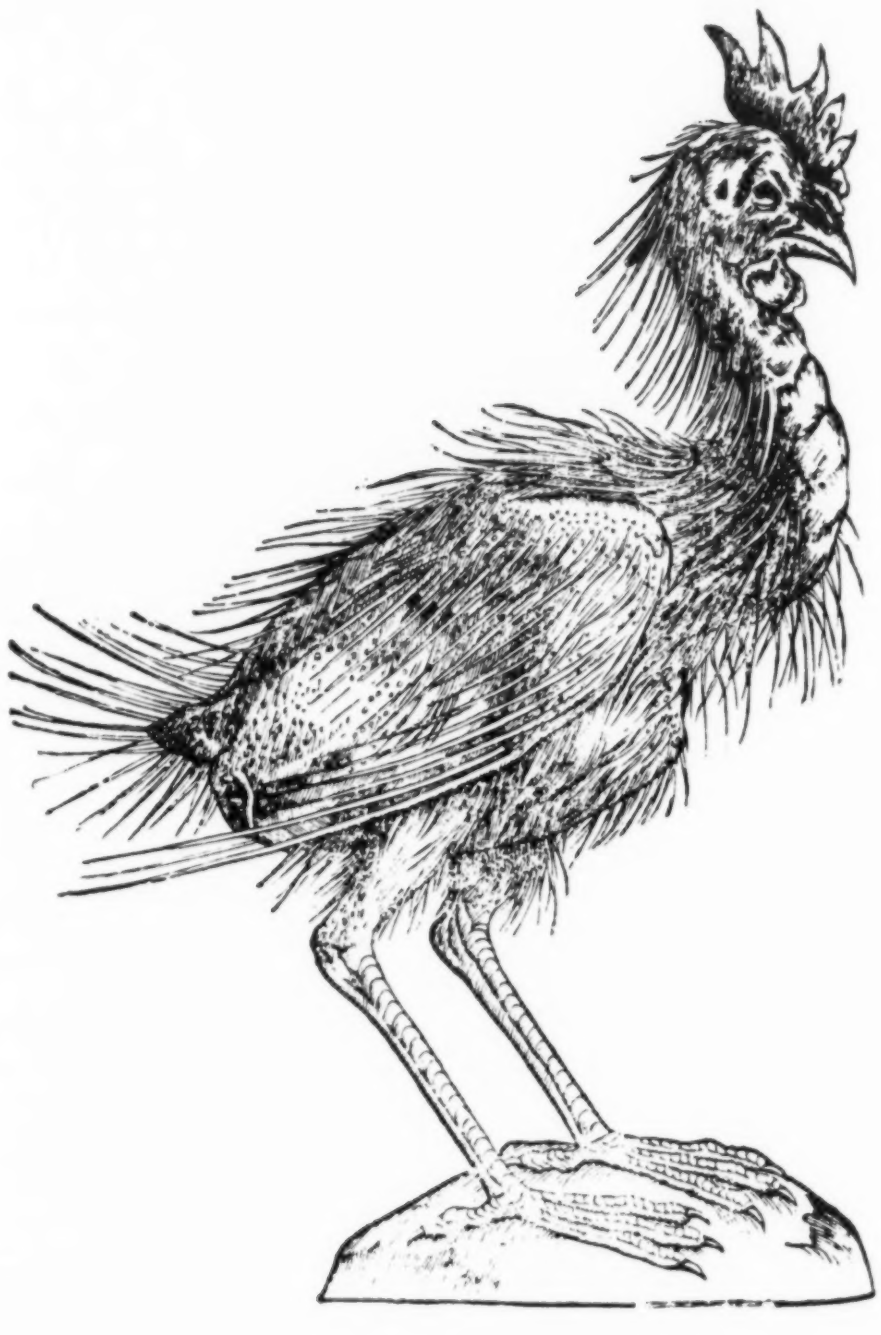
Typical posture of "Porcupine" female 2265A. It is doubtful whether this peculiar behavior had any direct association with the feather defect. No evidence of its heritability was obtained.

They have so far produced only two offspring which have lived to feather out, but both were Porcupine.

While these numbers are small, they strongly indicate Porcupine to be inherited as a Mendelian recessive, with only a single factor difference between Porcupine and normal. The observed frequencies do not in every case fit the expected as closely as might be desired, but the deviations are not such as to indicate the character to be anything other than a simple recessive. In the matings of F_1's together the Porcupines are in excess of expectation, but in the backcrosses to Porcupine it is the normals which are more numerous. The types appearing in the progeny are consistent in every case with what is expected. In the first cross (part *a*) of normal with Porcupine, only normal young were produced. These normal F_1's, back-crossed to Porcupine (part *d*), produced normal and Porcupine in approximately equal numbers. The normal F_1's mated with normal unrelated females have produced only normal offspring, as shown in part *c* of the table. Mating two normals together, one of whose parents in each case was Porcupine (part *b*), resulted in the production of normal and Porcupine in a ratio approaching three normal to one Porcupine. Finally, two Porcupines together produced only Porcupine (part *e*).

That the character is not sex-linked is shown by the fact that at least one Porcupine male was produced in mating 2309, where both parents were normal. Were Porcupine sex-linked, all the male progeny from this mating would be normal, because the female used was a normal F_1, and normal is certainly dominant to Porcupine.

We have at present no evidence of the gene for Porcupine being linked with any other known factor in pigeons.



A RENAISSANCE "PORCUPINE" FOWL

Figure 7

A domestic fowl with a feather defect showing strong resemblance to the condition here described as "Porcupine" in pigeons. From Aldrovandi's "Ornithologia," published in 1600.

Discussion

In addition to the problem of the inheritance of Porcupine as it occurs in the Drives stock, and which appears to be entirely simple in its inheritance, the question of the occurrence of this mutation in pigeons and in birds generally is an interesting one. As previously mentioned, the appearance of the character in the Fantails and in the Homers was in all ways similar (including the microscopic structure), but whether they were actually due to the same gene could be determined, of course, only by breeding tests, which were impossible under the circumstances. Our search of the pigeon literature has revealed no mention of a condition which we could identify as Porcupine, and if it is so uncommon as this would seem to indicate, it may seem strange that it should have cropped up in a period of thirteen years in two different breeds and hence in stock presumably entirely unrelated. There is a possibility in the case of the Fantails, however, that there may have been an outcross at some not very remote time in the ancestry of the birds concerned. This is suggested by the fact that the female (1356A) of the original cross proved, when bred to a blue Homer, to be carrying the *A*-factor in her sex chromosome. Our experience with all other white Fantails is that they do not carry this factor; in fact, this is the only time we have observed it in the Fantail breed, since it does not occur in any of the standard colors of the Fantails.*

Dr. J. Krizenecky, who has recently been working at the Station for Experimental Evolution at Cold Spring Harbor in association with Dr. Oscar Riddle, informs us that they have there what from appearance seems to be the same mutation, though again its genetic identity could be proven only by breeding tests. Dr. Krizenecky has been studying the physiological basis of the condition, and states that Dr. Riddle has made extensive studies on its inheritance but that those results have not yet been published. He has termed his mutation "scraggly" and has published a figure (Benedict and Riddle[2], p. 497, Fig. 1) of a single feather. If this is a typical "scraggly" feather it appears doubtful that this mutation is the same as our Porcupine.†

We have made no systematic search of other poultry and bird literature for the occurrence of this mutation, but Professor F. B. Hutt of the University

*Its presence in recessive reds and yellows could be detected only by breeding tests. We have not investigated these varieties at all extensively.

†This dissimilarity has since been substantiated by an examination of Riddle's birds.—*L. J. C.*

of Minnesota has called our attention to a figure of a fowl in Aldrovandi's classical *Ornithologia*,[1] in which, though crudely presented, there is a striking resemblance of the plumage to that shown in the photographs accompanying this paper. Aldrovandi's plate is labeled "Gallina ferè petrificata," but there appears to be no allusion to it in the text. His figure seems of sufficient interest to warrant its reproduction herewith (Figure 7).

Summary

1. An abnormal feather structure of pigeons, called "Porcupine," is described. Barbs and barbules develop imperfectly and later become largely abraded, leaving in many cases little but the quill.

2. This mutation was found independently in a white Fantail stock, and thirteen years later in Homers.

3. "Porcupine" is inherited as a simple Mendelian recessive to normal. Heterozygous birds appear to be entirely normal.

4. While some of the Porcupine birds exhibited subnormal nervous coordination, as indicated by "waltzing" and flexure of the neck, these conditions are not uniformly characteristic of Porcupines.

5. No reference to this mutation was found in early pigeon literature, but Aldrovandi has figured a condition in the domestic fowl which appears very similar.

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TABLE I—Summary of Porcupine Crosses

Mating Number	Type of Mating ♂ × ♀	Progeny Normal	Progeny Porcupine
(*a*) 2267	PP × pp	7	0
Expected		7	0
2309	Pp × Pp	17	8
(*b*) 2371	Pp × Pp	5	3
Total		22	11
Expected		24.75	8.25
2312	Pp × PP	1	0
(*c*) 2319	Pp × PP	5	0
Total		6	0
Expected		6	0
2313	Pp × pp	5	3
2318	Pp × pp	4	5
(*d*) 2355	Pp × pp	4	1
2405	Pp × pp	1	1
Total		14	10
Expected		12	12
(*e*) 2406	pp × pp	0	2
Expected		0	2

PP represents homozygous normal; pp, homozygous porcupine; Pp, heterozygous F_1, phenotypically normal. Part (a) is mating of normal unrelated male with porcupine female; (b), F_1 male with F_1 female; (c), F_1 male with normal unrelated female; (d), F_1 male with porcupine female; (e), porcupine male with porcupine female.

RECENT WORK ON HUMAN CHROMOSOMES

A Review

THE questions of the number and character of the sex chromosomes in man have been of great interest ever since it was discovered that these small bodies are the carriers of the hereditary substance and are bound up with sex determination. During the past year several noteworthy contributions have been made to this subject which extend our knowledge to a considerable number of individuals of different races and which seem to settle once and for all the question of the diploid number in the male. A brief resumé of the general subject of human chromosomes will serve to show the nature of the contribution made in the papers reviewed below.

In 1912 Winiwarter published his celebrated paper on human chromosomes in which he gave the diploid or somatic number for the male as 47 and for the female as 48. Although, in this paper, the sex chromosome was not specifically identified during maturation, this author concluded from the odd number of the male and other evidence that it was of the so-called *X-O* type. For some years following, the high number reported by Winiwarter was not confirmed in papers dealing with this subject, on the contrary the bulk of the evidence seemed to indicate that 24 was more nearly the correct count. Then in the early part of the past decade three observers, two in Japan and one in this country, published extensive papers which virtually substantiated Winiwarter's observations. Independently, these observers agreed that the diploid number for the female must be 48 and that the reduced number in the male was 24; they disagreed on the diploid number in the male. Oguma and Kihara working on the testis of a Japanese subject reported 47 chromosomes in spermatogonia, while Painter working with White and Negro testes found 48 elements. The real point at issue was the question of sex chromosomes. The Japanese investigators described a single *X* sex chromosome in the male, while Painter found an *X-Y* sex complex. Later, Winiwarter and Oguma in a joint paper based in part on new material failed to observe a *Y* sex chromosome such as Painter had described and reaffirmed their earlier conclusions that only a single *X* was present in the material studied by them. In the meantime a number of other mammals were studied, including numerous marsupials both in this country and in Australia, rodents, two species of monkeys and other forms, all of which showed uniformly an *X-Y* sex complex similar in form and behavior to that described by Painter for man and thus indirectly supporting his findings. It was recognized by all, however, that it was possible that in man just as in a certain species of insects the *Y* chromosome might be lacking from some individuals and present in others.

In view of the facts just presented it was very desirable that the spermatogenesis of man should be studied on new material by other observers to determine the character of the sex chromosomes. For the *X-Y* complex found in mammals generally has a highly characteristic form in the first maturation division and should be easy to identify in well-fixed material. Furthermore, in view of the possibiiity that some individuals might lack *Y* chromosomes it was important to have chromosome counts on as many individuals as possible.

The work by Evans and Swezy* at

*The Chromosomes in Man, Sex and Somatic, by Herbert M. Evans and Olive Swezy. Pp. 65, 11 plates and 8 text figures. Memoirs of the University of California. Vol. 9, 1929.

the University of California is a very thorough and extensive contribution and is outstanding in the number of individuals studied, in the variety of tissues examined and in the completeness with which the various stages of spermatogenesis have been worked out. Abundant and critical evidence is presented for *X*-*Y* sex chromosomes, similar to those previously described for man and other mammals, and the diploid number for both sexes is found to be 48 chromosomes.

Testicular material from 13 adult males (11 from executions) was examined, and in six of these subjects critical chromosome counts could be made. Among these six individuals were representatives of White, Negro, Mexican and Indian races. Somatic counts were made on two embryos, one male, the other female, on the uterus of a young girl and on fragments of a lip carcinoma taken from a man 55 years of age.

A total of 28 critical figures from five different males shows that 48 chromosomes are present in spermatogonia. The reduced or haploid number found in primary spermatocytes is 24, a conclusion based on 48 counts from six different subjects. Thirty-nine critical counts on four different subjects show that 24 chromosomes are invariably present in secondary spermatocytes. The last supplies a much-needed bit of evidence for the presence of a *Y* sex chromosome because Painter had not made satisfactory counts for this period. Considerable attention is devoted to the interkinesis stages and the history of the *X*-*Y* sex chromosomes is stressed. The *X* chromosome is a medium-sized element, the *Y* the smallest element of the entire complex. The *Y* chromosome may be easily recognized in spermatogonia because of its small size. In primary spermatocytes the *X* and *Y* are paired together and segregate to opposite poles during this division. In part of the secondary spermatocytes the *Y* chromosome may be recognized among the 24 elements. In other cells (those receiving an *X* chromosome) no *Y* can be found, although 24 chromosomes are present. Mature sperm are thus of two sorts, one type carrying a *Y* and the other an *X* sex chromosome.

Numerous mitoses were present in a white male embryo about 33 millimeters long. Forty-eight chromosomes were found, including the small *Y*. A Japanese female embryo of about 25 millimeters also showed numerous cells with 48 chromosomes, but no *Y* element could be seen. Dividing cells in the uterus of a young Negress gave a count of 48 elements, among which no small *Y* could be identified. In the lip carcinoma material taken from an adult male numerous normal appearing mitoses were observed, which showed 48 elements, including the *Y*.

The authors made careful measurements of the lengths of the chromosomes in male and female embryos and graphs of these are given. A consistent difference in the length of the first (longest) pair was found in the two sexes. A comparison of the chromosomes of male and female rats revealed a similar condition in this rodent.

The paper is well illustrated with 105 figures on eleven plates, and with a number of text figures. The numerous alignments of the chromosomes together with graphs deserve special mention. Altogether, this is the most extensive and complete work which has appeared on human chromosomes to date and the conclusion that the eight males studied carry 48 chromosomes, including the *X*-*Y* sex chromosomes does not appear open to question.

Kemp, in a recent contribution,* is primarily interested in the number of chromosomes in the somatic cells of man and uses the tissue-culture method for this purpose. Pieces of spleen, liver and heart of human embryos were grown *in vitro,* and subsequently subcultures were preserved, stained and ex-

*Ueber das Verhalten der chromosomen in den somatischen Zellen des Menschen, by Tage Kemp. Pp. 20, with 22 text illustrations. *Zeitsch. f. mikr.-anat. Forschung.* Bd. 16, 1929.

HUMAN CHROMOSOMES
Figure 8

Above are the chromosomes as seen within the cells, in spermatogonial plates from two subjects. Forty-eight chromosomes are present, including the small *Y* sex-chromosomes. Below are the chromosomes arranged in order of size, with the sex-chromosomes at the right. The top row shows chromosomes from a spermatogonial cell; the second row those from a primary spermatocyte (with half the somatic number of chromosomes); the third, from a male somatic cell; and the fourth from a female somatic cell. Note that the sex-chromosmes in the male cells are unlike, the *Y* being smaller than the *X*, while in the female cell the two *X*'s are alike. Magnified about 2,000 times. From Evans and Swezy, *The Chromosomes in Man*. Plates I and 10.

amined *in toto*. Four embryos were used for this study; three were male in sex and measured 11.5 cm., 20.8 cm. and 30.5 cm. in length, respectively; one was a female embryo 19 cm. long. Numerous mitoses were found in the fibroblasts which grew out from the explanted tissue and a considerable number of critical counts were made. A total of 48 chromosomes was usually found in both the male and female cultures. Occasionally cells were encountered in which the author was in some doubt with regard to the interpretation of one or two contiguous or overlapping elements, but this did not affect the typical number of 48 by more than one or two elements. The paper is excellently illustrated with photomicrographs and camera lucida drawings of the same cells. A general review of pertinent literature is given, especially that dealing with somatic divisions in man.

The reviewer may remark that the drawings of the author clearly show the presence of the small *Y* sex-chromosome among the 48 elements found in male embryo material, while this small element is lacking in cells taken from the female embryo.

Another contribution* to this subject deals principally with pathological material. The author studied for the most part *in toto* preparations of the pleura and peritoneum of a normal ap-

†Ein Beitrag zur Kenntnis der somatischen Mitose beim Menschen, by Heinrich Karplus. Pp. 15, with 29 text figures. Zeit. f. Zellforsch. u. mikr. Anat., Bd. 10, 1929.

pearing embryo 12.5 cm. in length, but amniotic tissue from other individuals was examined. He finds that the chromosome number in the pleura and peritoneum is extremely variable and the paper is taken up largely with detailed descriptions of individual cells. The number may be as high as 64 or as low as 30 chromosomes. Aberrant division figures are commonly found, the author illustrating multipolar spindles, asymmetrical spindles, and monasters. The main point stressed is the irregularity in chromosome number in the somatic tissue examined, and the illustrations, both photomicrographs and pen drawings are good.

The observations of Karplus are in sharp contrast with the general uniformity in chromosome number reported for somatic cells by Kemp, but to the reviewer the source of this disagreement is quite obvious. Asymmetrical spindles and especially mutipolar mitoses, both of which Karplus found frequently in his material, must inevitably result in the irregular distribution of chromosomes to the daughter nuclei which come from such a division. The great variability in chromosome number observed by Karplus is just what we must expect to find under the circumstances. Cytologists generally accept aberrant division figures, such as those described as *prima facie* evidence of degenerating or pathological tissue, and the results reported by Karplus should be viewed in this light.

The observations of Evans and Swezy and of Kemp give us accurate information about the chromosome constitution of 14 new human subjects, 3 females and 11 males. In every case 48 chromosomes were found and in the males the *Y* sex element was identified. It would appear, therefore, that we are justified in concluding that 48 chromosomes are characteristic of the male sex as well as the female and that the sex chromosomes are of the *X-Y* type.

T. S. Painter.

Books Received

BOOKS are acknowledged in this column as received, and such acknowledgment must be regarded as sufficient return for the courtesy of the sender. As far as space permits, books that contain material of special interest to the readers of the JOURNAL *will be reviewed in later numbers.*

ANTHROPOLOGY AND MODERN LIFE, by FRANZ BOAS, Ph. D., professor of Anthropology, Columbia University. Pp. 246. 9 Chapters. Price, $3.00. W. W. Norton & Company, Inc., New York. 1928.

An anthropologist has recently put out a best seller devoted to explaining *why we behave like human beings* (or better, why the environment makes us behave any way it pleases). Perhaps we will some day be enlightened as to why some anthropologists behave the way they do when discussing heredity and environment.

FOUNDATIONS OF MENTAL HEALTH, by LEONARDO BIANCHI, Late Professor of Nervous and Mental Diseases in the Royal University of Naples. Translated by G. A. BARRICELLI, M. D. Pp. 277 8 Chapters. Price, $2.50. D. Appleton and Company, New York. 1930.

The first chapter of 46 pages is devoted to Eugenics. Truly, Psychiatrity is far ahead of Anthropology!

BLAISDELL INSTRUCTIONAL TESTS IN BIOLOGY, for Junior and Senior High Schools. Comprising twenty-five tests in Animal, Human and Plant Biology. *By* J. G. BLAISDELL, Chairman Biology Department, Charles E. Gorton High School, Yonkers, N. Y. Pp. 56. Supplement, Key and directions for scoring. Price, 32c. World Book Company, Yonkers-on-Hudson, N. Y., 1929.

One way to find out how much biology the young idea has absorbed. If it knows that the "Science of breeding better offspring is called 'Eugenics,'" it gets 100 on that question. If it knows that Burbank is a "prominent scientist" and a "famous horticulturist," two more questions are in the sack.

(*Continued on page* 72)

MALE-FEMALE GRAFTS

In *Mercurialis annua*

CECIL YAMPOLSKY

WHEN two elements of a graft are brought in contact an intimate relationship is established resulting in a communication between the two. The nature of the graft determines the degree of intimacy that is to be maintained. Strasburger[4] has shown that a protoplasmic connection between the cells of stock and scion is established which knits the two elements together. Thus materials move up and down the graft without much difficulty and the physiological activities go on unimpaired. In the grafting that is practiced in horticulture there is little morphological modification of the elements that take part in the graft. Grafting may result in the dwarfing of a plant, showing that mutual influence is exerted by the stock and scion. That a physiological influence is not entirely out of the question can be seen from the contention that in fruits, the flavor is influenced by the character of the stock. If that be the case there must be an intermingling of the substances from stock and scion.

The grafts that have provoked a great amount of interest are those of Winkler[5] with nightshade and tomato —the plant chimera grafts. In such grafts there is a mutual and definite influence exerted by the elements of the grafts. The various forms of grafts secured by Winkler continued to grow, to be sure, with some difficulty. Whether the outer layer or layers were of tomato cells or nightshade cells, the effect of this more or less symbiotic relationship did not alter the potential expression of the cells of either the tomato or the nightshade. When opportunity presented itself nightshade cells gave rise to nightshade branches and tomato cells to tomato branches.

The fact that in a nightshade-tomato chimera the nightshade cells of the root, notably the root hairs, absorbed the substances from the soil did not prevent the tomato cells on the inside from selecting from the substances in solution absorbed by the nightshade cells, those chemicals necessary for them. In the chimeras where tomato cells were on the outside and nightshade on the inside reverse conditions were maintained.

Sex-Differences in Blood and Sap

Recently Manoiloff[1] published the results of investigations upon the constitution of human male and female blood. On the basis of empirical tests he claims to be able to distinguish between them. Moreover, he maintains that the same technique applied to extracts of chlorophyll of male and female plants gives a positive test for sex differentiation. Satina and Blakeslee[2] substantiate Manoiloff's results with plants.

In an effort to study some of the factors that may influence sex expression in plants, especially in plants whose sexes are separated, attempts were made to graft male and female plants together. If there be anything in the hormonic theory of sex or if the elaborated substances of the male and the female are distinct, then a co-mingling of such substances should show a mutual influence either on the physiologic expression or on the morphologic expression or on both. The male and female plants used offered no serious difficulty so that the grafts were unexpectedly successful.

The plant used was *Mercurialis annua*, a Euphorbiaceous annual weed. This plant has been the subject of a number of investigations pertaining to sex-inheritance so that the genetics of the sex of the species is known. The characteristic growths of the plants

MALE AND FEMALE PLANTS OF MERCURIALIS

Figure 9

The male plant is on the left, the female on the right. The enlarged inserts of the flowers show the principal difference between the two sexes. Th male flowers are borne on spikes extending beyond the leaves; the female flowers are generally borne in the axils of the leaves.

are shown in Figure 9, male and female respectively. The outstanding characteristic is the manner in which the flowers are borne. In the female the flowers as a rule are sessile and are borne in the axils of the leaves. In the males the flowers are borne on interrupted spikes which surpass the leaves. This difference is shown in Figure 9, in the plants themselves and in the inserts showing the flowers enlarged. The characters are sufficiently contrasting so that there is no mistaking one for the other.

Grafting Technique

For grafting purposes it has been found most practicable to grow plants together in the same pots. This can be begun when the plants are very

young since their sex can be ascertained when they are only a few weeks old. When the plants are three to four months old they can be joined together. The method which yielded the best results is the simple one of inarching and removing from the adjacent sides of the two plants sufficient tissue to expose the cambium. The wounded areas were strapped together by means of adhesive tape and raphia. The method of grafting is shown in Figure 12). The plants are allowed to remain in that condition for a month to insure healing. The plants maintain their independence except at the one point where the union is effected. The plant that is to be scion is gradually pruned to remove as much of transpiration surface as possible so that when it is completely severed from its root-system the adjustment is not too taxing. It has also been found feasible gradually to sever the connection between the scion and its root system. Four types of combinations have been made:

1. Male scion growing on female stock, each element of the graft producing branches, leaves, and flowers.
2. Female scion growing on male stock, each element of the graft producing branches, leaves, and flowers.
3. Male scion growing on female stock, the male element only giving rise to branches, leaves, and flowers.
4. Female scion growing on male stock, the female element giving rise to branches, leaves, and flowers.

Figure 12 *A* and *B* shows two grafts three months after they were united. The female element has been cut back severely. The lower portion in each graft is female, seed and female flowers can be seen. The upper part is distinctly male as evidenced by the male inflorescences. The plants when photographed were healthy in color showing that neither part of the graft had had suffered as a result of the union. From time to time judicious pruning was necessary in order to prevent too rapid growth of one to the detriment of the other. Such grafts when isolated bore fruit in abundance so that both elements were functional.

Figure 10 (left) shows a successful graft in which the male and female elements are equally vigorous. This also was a three months old graft. The two parts had grown so firmly together that no additional support was necessary at that time. In this Figure the place where the female element was severed from the mother plant can be seen. The striking difference between the two elements is brought out—the male with its inflorescences in the form of interrupted spikes—the female with its sessile inflorescence.

Figure 10 (right) represents a graft where the female element has outdistanced the male element. The female branches were pruned severely to allow the male element sufficient room and light to develop. By keeping down the growth of the female element the male grew until it was equal in vigor and in size to the female. The presence of the seed, shown clearly in the upper half of the photograph, attests to the fact that the reproductive vigor remained unimpaired.

Figure 12 *C* represents a graft of a female upon a male where only the female elements produce branches, leaves and flowers. The place of union of the scion and the stock shows very plainly. The photograph was taken four months after grafting and the male stock never produced branches, leaves or flowers. The plant lived for nine months growing into a vigorous plant. Female flowers were produced in profuse numbers and when placed near a male produced thousands of seeds.

Figure 12 *E* shows a graft seven months old where vigor is decidedly on the decline. The male element which was grafted on was as vigorous as the female throughout the life of the plant. Where the elements of the two plants have united a definite callous tissue was formed. From that region no branches or leaves were produced.

Figure 11 shows a graft from which a large number of branches had been

RECIPROCAL GRAFTS

Figure 10

A three-months-old graft of female scion on male stock is shown at the left, in which both elements are equally vigorous. At the right is shown a graft in which the female element (stock) has outdistanced the male scion, even though the female branches have been pruned heavily.

A SEVEN-MONTHS-OLD GRAFT

Figure 11

Female stock and male scion with many branches cut away to show the two elements. In none of the grafts was there any evidence of modification of one element by the other.

A GROUP OF GRAFTS

Figure 12

A, B, Three-month-old graft, female stock on male scion, the female element severely cut back; *C,* male stock, with female scion producing all branches, leaves and flowers; *D,* a nine-month-old graft, male scion at right; *E,* male graft on female stock, male element less vigorous than female. Variations in vigor were noted, but no morphological changes due to influence of stock on scion.

removed to show the male and female elements. This grafted plant was seven months old when it was photographed. Figure 12 *D* shows another graft in which the male element is decidedly less vigorous than the female element.

The graft experiments have been repeated sufficiently often to warrant the statement that with the exercise of a little care grafts can readily be made at any time providing the branches selected for grafting are not too woody. The grafts live from seven to nine months after the grafting. Usually plants are selected that are three months old so that the complete life span of a graft is from ten to twelve months.

I have already stated that the theoretical consideration underlying this experiment was to determine whether there is any influence of stock upon scion and scion upon stock. Quite recently Souville[3] has called attention to sex dimorphism that exists in *Mercurialis annua* and he has pointed out sex-limited differences between the males and the females. The reported differences are tabulated below.*

Careful observations were made in the first place to ascertain whether such differences exist. Plants answering to such descriptions can be found in a population of *Mercurialis annua*. However the number of male and female plants that do not answer to those descriptions is too large to give weight to a belief in the existence of sex dimorphism other than that of the inflorescence. In the cultures examined over a period of years female plants were found in abundance to answer the description of the male, even to the extent of bearing their flowers on elongated peduncles that equalled in length the spikes of the males. In the plants that were to be grafted differences in vegetative expression occurred. During the whole life of the grafts morphological modification of either the male by the female or of the female by the male were not in evidence—if they were they escaped my attention.

To test out the assumption that secretions from the female differed from those of the male, grafts were isolated so as to allow fruit and seed setting from the male and the female flowers of the graft. Thus a male branch grafted on to a female plant would receive nourishment in part from the female so that the liquids traversing from the roots of the female through part of its stem would then pass into the male and thus insure a mingling of substances from both. The downward movement of substances from the male would also mingle with those of the female. In the same manner a female branch grafted onto a male plant would receive nourishment in part from the male plant and there would be a mingling of substances.

The question arose whether there would be any influence upon the proportion of sexes in such grafts. Would the pollen grains produced by the male branch be influenced by the secretions from the female plant? Could we then expect offspring from such a union to produce a larger number of females? Conversely, could we expect a larger number of male offspring from a graft where a female branch was grafted onto a male plant? Would the secretions from the male influence the sex expression of the egg cells and lead to a preponderance of males?

Sex-Differences in *Mercurialis Annua

	Male	*Female*
Inflorescence	interrupted spike	sessile
Color of plant	light green	dark green
Leaves	long	short
Petiole	long	short
Internodes	long	short
Angle of branching	45°	90°
Branches	less ramified than female	

Grafts were isolated to insure self pollination and the seed collected. Such seed is being tested out to ascertain their sex. Up to the present relatively few seed (about 100) were tested out but no startling influence has been noticed, although the number is too small to warrant any conclusion, the close approach to a 1 : 1 ratio secured up to the present suggests that there has been no marked influence upon the sex of the offspring.

In the case of the graft represented by Figure 12 *C* the stock of male origin supplied to the scion of female origin the liquids absorbed from the soil which of course passed through male tissue into female tissue. The graft was placed together with a male and a profuse, setting of seed resulted. The offspring of such a union have not yet been studied. Upon purely theoretical grounds such seed would receive secretions from the male through the stock, from the female through the scion and from the male through the pollen grains. The male influences would theoretically be stronger. This is being tested out and a later report will deal with the results.

The value of the Manoiloff reaction has not been estimated in my grafts although an investigation of the reaction is planned. In the preliminary investigation of the males and females that were to be grafted, the results of the tests were so conflicting (which of course may be due to faulty technique) that the investigation was put off until a later date. Nevertheless grafts of the kind described should throw some light on the nature of the substances which result in a physiological difference in the sexes.

Male and female elements can live together in the same graft without apparently influencing the morphological expression of either the stock or the scion. There can be no doubt that an intimate relationship is established between the cells of the elements of the graft allowing for for the transportation of the substances up and down the grafts. In *Mercurialis annua* in common with other plants the reproductive elements are produced *in situ* so there can be no question of ferments or hormones which circulate and influence sex expression.

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3. Souville, M. G. Observations sur la dimorphism sexual du *Mercurialis annua* L. *Rev. Gen. de Botan.* 37:49-62. 1922.

4. Strasburger, E. Ueber Plasmaverbindungen pflanzlichen Zellen. *Jahrb. wis. Bot.* 36:493-610. 1901.

5. Winkler, H. Ueber die Nachkommenschaft der Solanum Pfropfbastarde und die Chromosomenzahlen ihrer Keimzellen. *Zeit. für Bot.* 2:1-34. 1910.

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DIE UNFRUCHTBARMACHUNG AUS RASSENHYGIENISCHEN UND SOZIALEN GRUNDEN, *by* Dr. Otto Kankeleit. Pp. 112. 8 Chapters. J. F. Lehmanns Verlag, Munchen, 1929.

Sterility is a problem that is giving German eugenists much concern.

MEMORIAS DE LA REAL SOCIEDAD ESPANOLA DE HISTORIA NATURAL. *By* Don Ignacio Bolivar y Urrutia. Pp. 892. 2 Volumes. Illustrated. Museo Nacional de Ciencias Naturales, Madrid, 1929.

LA VARIATION ET L'EVOLUTION. *By* Professor E. Guyenot, University of Geneva. Volume I, Variation. Pp. 460. 3 Parts, 14 Chapters, 46 Illustrations. Price, 32 Fr. Gaston Doin et Cie., Paris, 1930.

A NEW MUTATION IN MAN

Hemophilia-a

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IN the process of studying "hemorrhagic diathesis" we met with a new genotypic disease which modern classification does not include. Careful study of the genealogy of this case showed that we have here a newly arisen mutation. The clinical manifestations of the latter can be seen from the following medical history:*

Nicholas P., born in 1886, Russian barrister, turned to us for medical advice in 1923. Since early childhood he suffered from violent nasal and gingival hemorrhages, which occurred spontaneously as well as after the slightest trauma. At 17, after the extraction of a tooth, a most violent hemorrhage took place, lasting a week and a half. Occasional small incisions bled persistently. At the age of 17 and 18 several attacks of hemoptysis occurred. At the age of 24-30 nasal hemorrhages discontinued so that at the time he believed himself to be quite healthy. At the age of 30 he suddenly developed weakness, shortness of breath, heart palpitation and black-colored feces appeared. A physician diagnosed stomachal and intestinal hemorrhage. It lasted ten days. After this similar hemorrhages occurred every five or six months, lasting ten days, and each time the patient required nearly two months to recuperate. From 1918 to 1920 there were no intestinal hemorrhages, only the gums bled occasionally. Detailed examination of the patient revealed no particular digression from the normal state. Analysis of the contents of the stomach was made twice during the period of hemorrhage, and each time the blood reaction gave negative results.† The patient is continuously under our observation.‡ Hemorrhages (always intesinal) occur suddenly from four to seven times a year, oftener during periods of intense work, and last about two weeks. At the beginning of our examination the blood was analyzed every day during periods of hemorrhage and between these from two to eight times a month. The quantity of hemoglobin fell to 13-25 per cent during the hemorrhages, and the quantity of erythrocytes fell sharply. The color index varied between 0.4-0.65. During the period of anemia the usual changes of erythrocytes were noticed. The quantity of leucocytes and the leucocytic formula always kept within normal bounds. The quantity of thrombocytes is always normal (varying between 126,000 and 300,000). The coagulative property of the blood is also always normal. The quantity of fibrinogen in the blood (determined by the method of Wohlgemuth) is 250 (i. e., normal). No remedies used to stop bleeding produced any effect. Transfusion of blood was tried three times (Dr. J. M. Brouskin) with insignificant results.

In 1925 the hemorrhages were so frequent and violent that the patient became almost incapable of working. The latter fact induced us (by analogy with Werlhof's disease) to have recourse to the removal of the spleen.

The operation was performed on December 28, 1925, by Prof. I. A. Hertzen and, on the whole, went off well; but after several hours there appeared symptoms of hemorrhage into the abdominal cavity, which necessitated transfusion of blood. The spleen was slightly enlarged, but its histological analysis did not present any specific pathological

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*The pathology of this disease will be described in detail in the German medical press.

†For this reason it is assumed that the hemorrhages are intestinal.

‡During the hemorrhages the patient was at the Clinic of the Moscow First State University. (Director, Prof. Pletneff.)

aspect. On the fifth day after the operation an abundant intestinal hemorrhage occurred. The patient had extensive post-operative phlegmon of the subcutaneous fatty cellular membrane. It was necessary to make a large incision, which caused but normal loss of blood. During the first six months after the operation hemorrhages no longer occurred. In the middle of 1926 periodical intestinal hemorrhages began again to grow more and more intense. The patient lost at times up to 20 per cent of hemoglobin a day, reached a state of sharp anemia, and after this recuperated with difficulty. (In each of the years 1927 and 1928, there were five such paroxysms.) At the end of 1927, on account of frequent hemorrhages, the patient became a confirmed invalid.

Family History of Bleeding Tendency

The heredity of the patient—in respect to the bleeding tendency—can be illustrated by the chart (Figure 13.)

This shows that we possess information concerning seven generations of this family, a total of 72 persons (including in that number also the individuals who married members of this family). The first five generations have died out completely (except two wives of members of the family—V-5 and 7). Of the 25 persons remaining alive, 15 have been examined by us. From the testimonies of these persons and also from written communications we succeeded in gathering the following information concerning the bleeding tendencies of the patient's relatives:

The first bleeder appeared in the fourth generation; of two sisters of normal parents one was a bleeder and one normal. All the descendants of the normal sister have been free from any trace of the bleeding tendency. The distribution of the defect in the descendants of the affected sister is shown in the chart. The individuals marrying into this line were all normal and of them no further data seem necessary. Concerning those in the direct line the following information was obtained:

Alexandra (IV-5) during all her life suffered from nose-bleed; once "almost died" of it. A tendency to ecchymosis was noted. Died at the age of 42 of a uterine hemorrhage (in 1863).

Alexander (V-1) the removal of the tonsils caused violent hemorrhage. Died at the age of 70.*

Mary (V-3) suffered from nasal and gingival hemorrhages. According to her relatives "she always had blood on her lips." Died at the age of 78.

George (Youry) (V-4) suffered from hemoptysis (tuberculosis was excluded); "lost blood excessively"; slight nasal hemorrhages. Abundant hemorrhages were caused by extraction of teeth. Died at 63 of intestinal hemorrhage.

Michael (V-6) suffered from childhood from nasal and gingival hemorrhages. At the age of 20 had an attack of hemoptysis (as stated by physicians not caused by tuberculosis) and at 26 a very violent intestinal hemorrhage. After the age of 25 nasal hemorrhages became less frequent. At the age of 48 an intestinal hemorrhage occurred which caused death in 3 days.

Helena (V-8) did not suffer from hemorrhage. Died at 70.

Constantine (VI-1) aged 44. In good health.

Olga (V1-3) suffered from the age of two from exceedingly abundant nasal hemorrhages, which decreased with the advent of menstruation (at the age of 14) and then stopped definitely; died at 52 of pulmonary tuberculosis. The extraction of milk-teeth caused abundant bleeding. Her son (VII-1) died the second day after birth.

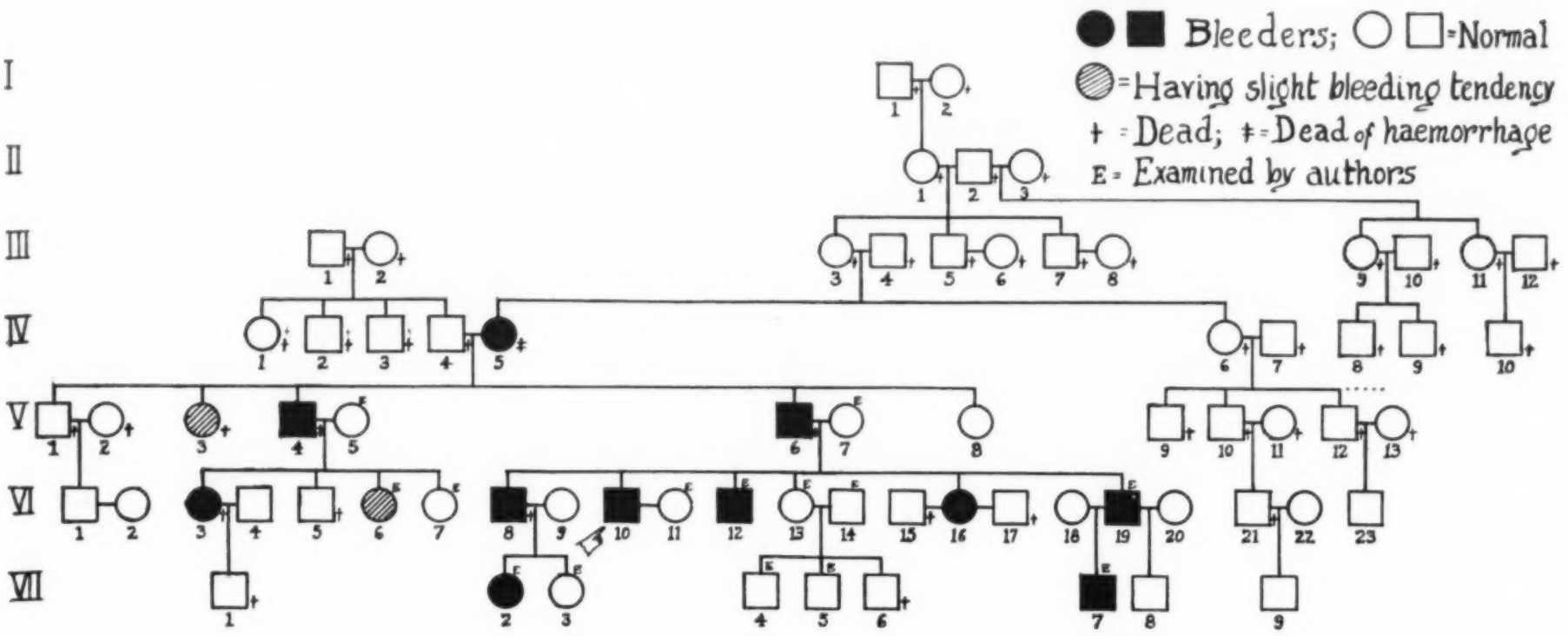
Boris (VI-5) died at the age of 3 of dysentery together with meningitis. He did not suffer from hemorrhages. (Also in connection with dysentery no exceptional hemorrhages took place).

Helena (VI-6) born in 1884. Since the age of 10 suffered to a small degree from nasal and gingival hemorrhages. Thrice had slight attacks of hemoptysis. Surgical interference (an incision on the arm involved by phlegmon) caused comparatively abundant bleeding. Menstruates since the age of 14, normally.

Anna (VI-7) born in 1886; in good health.

Constantine (VI-8) born in 1885; suffered from infancy (since the age of a few months) from abundant nasal and gingival hemorrhages. Had a fall at the age of 8,

*We did not include him in the number of bleeders inasmuch as it is certain that he had no other hemorrhages and the removal of tonsils often causes abundant hemorrhages in perfectly healthy people.



INHERITANCE OF DOMINANT HEMOPHILIA

Figure 13

Inheritance chart showing three generations before the mutation appeared, and the inheritance of the mutation for the three succeeding generations. The classical hemophilia is evidently a dominant. The coagulation of the blood is normal, and the bleeding appears to be caused by a defect in the capillaries.

after which he vomited blood during two days. At the age of 14—very violent hemoptysis. At 26 a violent nasal hemorrhage obliged him to take to bed. Physicians called could not stop the bleeding for several days. About the age of 30 the hemorrhages decreased. Died at 32 of a wound in the hip (in the war).

Nicholas (VI-10) born in 1888—the patient. According to his mother he had more hemorrhages during his childhood than any of her other children.

Alexander (VI-12) born in 1888, workman. from earliest childhood (since the age of a few months) suffered from abundant nasal and sometimes from gingival hemorrhages. Particularly abundant hemorrhages took place at the age of 12-22. The blood flowed during one or two days; he had to lie in bed for five or more days. In the winter the hemorrhages were more intense than in the summer. Small incisions as well as tooth extraction caused excessive bleeding. At about the age of 22 the hemorrhages stopped and now occur very seldom (excepting incisions). Has been examined by us: the hemoglobin, the erythrocytes, the thrombocytes, the coagulative property of the blood, are all normal.

Maria (VI-13) born in 1889; in good health.

Tatyana (VI-16) born in 1891. From the age of eighteen months to the age of 13 (beginning of menstruation) suffered from slight nasal hemorrhages. Cauterization of the tonsils performed at the age of thirty months caused abundant hemorrhage. Menstruation is normal. From childhood on has had constant bruises on her body. Artificial delivery (necessitated by eclampsia) caused a normal loss of blood, but on the ninth day a most abundant hemorrhage occurred. During typhoid (in 1924) a severe uterine hemorrhage took place lasting two weeks. In 1929 once during the period of menstruation a most abundant uterine hemorrhage occurred.

Gregory (VI-19) born in 1895, barrister. From early childhood (from the age of a few months) suffered chiefly from nasal and less from gingival hemorrhages; the bleeding tendency increased sharply at the age of 10-22; at that period he had to lie in bed on account of the hemorrhages for from one to seven days. Since about the age of 22 the bleeding tendency has markedly decreased and though the gums still bleed rather often, the attacks are much less intense. In 1928 the removal of wine-stone from the teeth caused rather abundant bleeding. Has been examined by us: the hemoglobin, the erythrocytes, the thrombocytes, the coagulative property of the blood are normal. According to his mother he had a lesser tendency to bleeding than any of her other children.

Elizabeth (VII-2) born in 1909. Since the age of eighteen months suffers from severe nasal hemorrhages, which have caused loss of consciousness. With the beginning of menstruation the nasal hemorrhages stopped but the gums still bleed occasionally. The menstruations take place after monthly periods, last about four days, formerly were very abundant, but recently their intensity has somewhat diminished. After the extraction of a tooth the bleeding lasted about five hours. Has been examined by us: the hemoglobin, the erythrocytes, the leucocytes, the thrombocytes, and the coagulative property of the blood are normal.

Marina (VII-3) born in 1911; in good health.

Vadim (VII-4) aged 13; in good health.
George (Youry) (VII-5) aged 9; in good health.
Wassily (VII-6) died at two years of measles. Did not suffer from hemorrhages.
Gleb (VII-7) born in 1920; from one year of age slight nasal and gingival hemorhages have been noted. Since the age of eight the hemorrhages strongly increased, so that in the morning the pillow, on which he sleeps, is all bloody.
Alexander (VII-8) born in 1923; in good health.

Summing up the above data, we note the following: We have here a sharply expressed genotypic disease, which attacks in the same degree males and females (seven affected males, four affected females, plus two "doubtful" ones).* It begins in early childhood (chiefly in infancy, but not later than at the age of two).† This disease takes a different course in different individuals. We have, for instance, succeeded in establishing that for some (VI-10, 19, VII-7)it increases at the age of 8 to 12 years, for others the bleeding tendency decreases (VI-3, VII-2) at about nearly the same age (14) and yet for others (V-6, VI-8, 10, 12, 19) this happens at the age of 22 to 30. But the decrease of the bleeding tendency does not always guarantee against relapses, which are sometimes more violent than the attacks in younger years (V-6; VI-10). In some the disease causes death (IV-5-42 years, V-4-68 years, V-6-48 years). It is further interesting to note that menstruation, evidently, does not particularly discommode the patients, and for VI-3 VI-16, and VII-2, with its advent the phenomena of bleeding decreased. The course of the disease is lighter in females than in males. In all cases violent hemorrhages are caused by rupture of tissues and take place spontaneously through mucous membranes; there are no hemorrhages into the joints‡ and no petechial hemorrhages (hemorrhages into the derma in the form of points); the number of thrombocytes is normal, the coagulative property of the blood also (these data have been repeatedly obtained during the periods of hemorrhage and between them).

Two members of this family (V-3 and VI-6) are but slightly affected (see the chart). We find that the fact of their being attacked by the disease is uncertain, because, as is seen from the above description, in their cases phenomena characteristic of bleeding tendency have found but a slight expression. One can say this in particular of VI-6, where the disease is evidently absent. It is also necessary to remember that they are both females, and the latter very often have a tendency to bleeding (by our data 40 per cent—more violently 19 per cent§).

Comparison With Hemophilia

This disease strongly differs from all kinds of hemorrhagic diathesis known to us up to date. Actually, the mode of inheritance speaks against hemophilia; we have here an autosomal dominant stigma, whereas hemophilia is known to be inherited as a recessive sex-linked character. This disease differs from hemophilia also in its clinical aspects. For instance, the fact that in the case of some members of this family the bleeding tendency does not decrease (as is noted in the case of hemophilia) but sometimes even strongly increases is not characteristic of hemophilia.¶ Also the coagulative prop-

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*See below.

†Only in the case of VI-6 the bleeding tendency is first noted at the age of 10, but her having the disease remains uncertain (see below).

‡A symptom characteristic of hemophilia.

§See our work Forme frusche der Werlhofschen Krankheit. *Ztschr. f. Kl. Med.*, Bd. 106.

¶This case is described in Russian literature as hemophilia in Prof. G. P. Saskarov's articles ("Studies on the analysis of the hereditary laws of hemophilia," Vratchebnoje Dielo, 1921, NN 22-26). (See page 10.)

But the author's genealogical data are exceedingly incomplete (and partly inaccurate), the blood was not analyzed, and the patients were not studied clinically, so that it is scarcely necessary to prove here specially the incorrectness of his interpretation.

erty of the blood, which has been determined very often, always gave normal results, and this took place not only on the days of hemorrhages, when the coagulative property in the case of hemophilia sometimes slightly increases, but also during periods quite free from hemorrhage. One can also definitely exclude Werlhof's disease. In the first place this is justified by the absence of petechial hemorrhages in the cases of all the bleeders of this family; and experience has convinced us that this symptom is one of the chief characteristics of Werlhof's disease. Secondly, observing the patient during six years and studying him hematologically during almost each attack of bleeding, we never discovered the constant symptom of Werlhof's disease—thrombopenia (sharp decrease and sometimes complete disappearance of thrombocytes in the blood). This case differs (clinically and genetically) from the case of "pseudohemophilia" described by Wilbrand.* We propose to name this disease *hemophilia—a* (from the word "autosomal")† One can hardly expect this term to be particularly successful, and therefore it is to be used only temporarily until the introduction of a rational nomenclature for mutations, the need of which, it can be added here, is already acutely felt.

Genetic Summary

This disease started by way of mutation as an autosomal dominant stigma. This is evident in the first case from the fact that the stigmata in which we are interested could not be discovered in the I, II and III generations and also in the case of the first patient's sister IV-6 (and of all her descendants); (the same can be said of the mutant's husband and his family). It must be pointed out here that the "skipping a generation does not anywhere appear; one of the parents of all individuals exhibiting this stigma (structure *Aa*) has the same structure. The second argument, which proves the actuality of mutation, is the monohybrid character of inheritance. In fact, all the descendants (total number 4) from the marriages *aa* × *aa* (in the posterity of the mutant there were two such marriages: VI-1 × 2 and VI-13 × 14) had the structures *aa* (absence of bleeding tendency). The descendants (total number 19‡ of the marriages *Aa* × *aa* there were five such—IV-4 × 5, V-4 × 5, V-6 × 7, VI-8 × 9, VI-19 × 18 × 20) can be classified as follows:

Aa (the bleeders)—10 individuals
aa (in good health)— 7 individuals
doubtful—2 individuals

If the "doubtful" be taken away, the ratio of *Aa* to *aa* (10 : 7) but slightly differs from the expected 1 : 1 Mendelian ratio. But even if we agree to count the "doubtful" cases as bleeders (*Aa*) then also we obtain the ratio 12 : 7; in this case the difference between the empiric numbers and the numbers expected in theory (9.5 : 9.5) is expressed by the value 1.15 of the standard error. Therefore the departure from the ratio 1 : 1 is not significant.

One must see the explanation of the difference in the manifestations of the stigmata described above in the influence of external conditions or in the action of modifying genes

As to the mechanism of the bleeding taking place, it must be looked for in some defect of the capillaries especially their epithelium, which increases periodically and under the influence of some endogenal factors leads to their insufficiency.

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*See: Bauer, Fischer, Lenz, *Menschliche Erblichkeitslehre*, III Aufl., München, 1927, p. 285.

†In Russian literature it was described by us under the name pseudo-resp.-heterohaemophilia.

‡We exclude from the summing up VII-1 (and therefore the marriage VI-3, 4) because the child lived but one day.

NORMAL AND ROOTLESS MAIZE PLANTS

Figure 14

The normal plant is on the left with four rootless plants to the right. The two rootless plants to the extreme right were blown and twisted by the wind until they were broken entirely free from their roots. Rootless is inherited as a simple recessive to normal.

HERITABLE CHARACTERS OF MAIZE

XXXIV—Rootless

MERLE T. JENKINS

Office of Cereal Crops and Diseases, U. S. Department of Agriculture, and Iowa Agricultural Experiment Station

MANY heritable characters of the seeds, seedlings and mature plants of maize have been reported and extensively studied. There is every reason to believe that the root systems also should exhibit large numbers of heritable characters. Due mainly to the difficulty of studying root characters no definite genes affecting root development have, to the writer's knowledge, been reported. Such a gene, called rootless *(rt)*, was recently isolated and is reported herein.

Description of Rootless

Rootless plants were first observed in the summer of 1926. They are characterized by their very limited root systems. Usually only a few "crown" roots develop and these are located at the lower end of the crown. Records on normal and rootless plants grown in the greenhouse showed them to have approximately the same number of seminal roots but to differ widely in the number of crown roots. The data in Table I show the numbers of crown roots for normal and rootless plants at various ages, these data being the means for 10 plants.

At 101 days after planting, at which time most of the plants were tasseling, the normal plants had two and a half times as many crown roots as did the rootless plants. The mean number of roots originating at each of the crown nodes on 10 plants of each kind gathered 101 days after planting are recorded in Table II.

TABLE I—The mean number of crown roots on normal and rootless maize plants grown in the greenhouse.

Days after planting	Mean number of crown roots *Rt*	*rt*
101	30.1	12.0
55	18.9	9.8
36	9.6	5.3

These data probably show less difference between the normal and rootless plants than would be expected under field conditions where the root systems of the normal plants would be much more extensive and those of the rootless plants probably would not be much increased.

The rootless character is first observed under field conditions when the plants are about 18 to 24 inches tall. About this time the above-ground parts become heavier than the limited root systems can support and the plants fall down. Many of the plants are blown and twisted by the wind until they are broken entirely free from their roots. Figure 14 shows the appearance of normal and rootless plants at this time.

Observations made on a number of rootless plants taken from the field indicated that the full diameter of the stem was reached at what appeared to be the ninth or tenth node of the crown.

TABLE II—The mean number of roots originating at each of the crown nodes of normal and rootless maize plants.

Nodes (numbered from bottom	Mean number of roots *Rt*	*rt*
1	4.3	3.4
2	3.5	2.7
3	3.3	2.1
4	3.6	1.9
5	3.6	1.7
6	5.6	.2
7	5.6	0
8	.6	0
All nodes	30.1	12.0

Figure 14—The two rootless plants to the extreme right were blown and twisted by the wind until they were broken entirely free from their roots. Rootless is inherited as a simple recessive to normal. The normal plant is on the left with four rootless plants to the right.

*The data on which this paper is based were obtained in connection with the corn breeding program conducted by the Office of Cereal Crops and Diseases, United States Department of Agriculture and the Farm Crops Section, Iowa Agricultural Experiment Station, cooperating.

Very few roots originated above what appeared to be about the fourth or fifth crown node.

Rootless plants naturally are somewhat reduced in vigor due to their limited root systems. When the plants have been staked up, however, no difficulty has been experienced in obtaining seed ears carrying several hundred kernels.

Inheritance

Rootless is inherited as a simple Mendelian recessive. Progenies grown from 14 self-pollinated plants heterozygous for the character consisted of 298 normal and 82 rootless where 285 normal and 95 rootless were expected. There was a slight deficiency of rootless plants which is not surprising in view of the depressing effect of the character. The deviation is 2.3 times its probable error.

Progenies grown from 14 plants heterozygous for rootless *(Rt rt)* which were backcrossed to the recessive *(rt rt)* produced 221 normal and 198 rootless plants where equal numbers of each class were expected. Here again there was a deficiency in the recessive class. The deviation in this case, however, is only 1.7 times its probable error.

Probably the most convincing evidence that only a single gene is involved comes from the proportion of homozygous to heterozygous plants among the normal plants in progenies from self-pollinated or backcrossed to rootless plants. Progenies grown from these plants showed that 13 were homozygous normal *(Rt Rt)* and 27 were heterozygous (*Rt rt*). The expected numbers are 13 1/3 homozygous and 26 2/ heterozygous. Progenies grown from 4 crosses between rootless plants produced 58 rootless and no normal plants.

From these data it seems reasonable to conclude that the rootless character is the result of the action of a single gene.

Summary

A heritable character in maize affecting root development is described.

This character has been named rootless (*rt*).

Rootless is inherited as a simple Mendelian recessive to the normal.

A Plant Patent Bill Before Congress

Amid the welter of tariff adjustments and prohibition hearings which have occupied much time in the second session of the 71st Congress, a bill was introduced by Mr. Townsend of Delaware which may have far-reaching importance to plant breeders. This bill revises the statute relating to patents so that new varieties of certain kinds of plants may be patented. The text of the bill is as follows:

A BILL

Amending section 4886 of the Revised Statutes

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That section 4886 of the Revised Statues be, and the same is hereby, amended to read as follows:

"SEC. 4886. Any person who has invented or discovered any new and useful art, machine, manufacture, or composition of matter, or any new and useful improvements thereof, or any new and distinct variety of asexually reproduced plant other than a tuber-propagated plant or a plant which reproduces itself without human aid, not known or used by others in this country, before his invention or discovery thereof, and not patented or described in any printed publication in this or any foreign country, before his invention or discovery thereof, or more than two years prior to his application, and not in public use or on sale in this country for more than two years prior to his application, unless the same is proved to have been abandoned, may, upon payment of the fees required by law, and other due proceeding had, obtain a patent therefor, *Provided*, That the words 'invented' and ' discovered' as used in this section, in regard to asexually reproduced plants, shall be interpreted to include invention and discovery in the sense of finding a thing already existing and reproducing the same as well as in the sense of creating."

By the terms of the bill only a few species would be eligible for patents, and the boundaries would not be very clearly defined. Strawberries, that tend

to their own vegetative propagation, would appear to be barred. Tomatoes, that normally reproduce in the United States by seed *can* be reproduced with human aid sexually; the status of such a plant would appear to be controversial. It is doubtless best to get into the field of plant patents gradually, but to get into it indefinitely might well prove fatal, at least to the Commissioner of Patents. Even with the admitted instability of taxonomy, the granting of patents for certain species might have obviated this difficulty, or even to certain clasess of flowers or fruits. "Apple" for purposes of legislation may be a more satisfactory label than *Pyrus malus*, and a rose might smell as sweet by any other name but for legal definitions, perhaps, the shorter and more familiar designation is to be preferred.

CORRESPONDENCE

Yellow Fatuoids in Oats

UNDER the heading "Yellow-kerneled Fatuoid Oats" an article appeared in this JOURNAL (Vol. 20, No. 2, pp. 67-70, February, 1929) by Stanton and Coffman in which the present writer is stated, in a paper entitled "Preliminary Studies on the Absence of Yellow Colour in Fatuoid or False Wild Oats" (*Welsh Journal of Agriculture*, Volume III, pp. 221-231, 1927), to question the occurrence of yellow fatuoids in oats and to hold the view that yellow colour inhibits the development of fatuoids. A reasonably careful perusal of this paper, however, would show that such inferences completely misrepresent the data there recorded and make clear the fact that the writer has neither questioned the occurrence of yellow fatuoids nor maintained the view that yellow colour of the grain inhibits the appearance of the fatuoid complex.

In respect of the occurrence of yellow fatuoids the writer has very definitely stated, on page 230: ". . . . that the behaviour of the yellow character in relation to the fatuoid or *fatua* characters differs in different varieties and with the different strains employed." That is to say, that in the yellow-grained types obtained by Crépin in the Golden Rain × *A. fatua* natural hybrid, and by Garber and by Stanton, Coffman and Wiebe, in the variety Aurora, the reaction between yellow and the *fatua* or fatuoid characters differs from that obtaining in *A. fatua* × Sixty Day, as described by Love and Craig and from that in the Golden Rain fatuoid and the Golden Rain fatuoid × normal cross as described by the present writer.

It may be added in this connection that previous to the publication of the paper in question yellow fatuoids had been obtained by the present writer in several F_3 families of the cross *A. nuda* × Scotch Potato: and further specimens have since been obtained in the variety Golden Giant.

In view of these facts, for the writer to question the occurrence or existence of yellow fatuoids would be extremely erroneous and fallacious.

Further, on the question of the relationship between yellow colour and fatuoid or *fatua* type of grain, the whole purport of the paper was to place on record the observation, that in the case of the fatuoid of Golden Rain and of the fatuoid segregates of the Golden Rain fatuoid × normal cross, yellow colour does *not* inhibit the fatuoid characters; but on the contrary, it, itself, is practically completely inhibited by the fatuoid unit.

This interpretation of the reaction between yellow and fatuoid characters, however, is the exact converse of that given by Love and Craig (*American Naturalist*, Volume 52, pp. 369-383,

1918), in connection with a somewhat parallel phenomenon in the *A. fatua* × Sixty Day cross. In the latter the F_2 segregation for *fatua* versus normal or *sativa* types of grain showed fairly close agreement with expectation, whilst the colour segregation, especially for grey and yellow, did not. These authors nevertheless conclude that the negative correlation between the yellow and *fatua* characters (there being no yellow-*fatua* segregates) was due to yellow, or a factor associated with it, inhibiting the fatua or wild base complex. On this basis of interpretation, it should be expected that the *fatua* segregates would show a deficiency in numbers, whilst the colour classes should show normal Mendelian segregation with close agreement, phenotypically as well as genotypically, with numerical expectations. Love and Craig's data, however, do not conform with these requirements, their F_2 segregation figures being as follows (ex Table III):

For Type of Grain:
Observed—Wild Base 123, *sativa* type 297
"Expected," 1:3 basis 105, " " 315
For Colour of Grain:
Observed—
Black 310, Grey 92, Yellow 18
"Expected"—
12:3:1 basis 315, " 78.72 " 26.25

Clearly the numbers in the Wild Base class are high, whilst the numbers in the Yellow class are low, and the deviations are the exact converse of expectation on the basis of Love and Craig's interpretation. It was, therefore, suggested by the present writer that the reaction between Yellow and Wild Base in this material might well be similar to that obtaining in the Golden Rain fatuoid × normal cross and therefore admit of a similar interpretation, namely, that the Wild Base inhibits Yellow colour rather than conversely, that Yellow colour or some factor associated with it inhibits the *fatua* or Wild Base complex.

Arising from such observations as these, the writer fails to comprehend how Stanton and Coffman can conclude that "Jones, as the result of his studies on the absence of yellow colour in certain fatuoids or false wild oats, intimates the possibility of yellow colour inhibiting the occurrence of fatuoids in oats." This intimation was emphatically not made.

Following upon the appearance of Stanton and Coffman's article, further comments have been published in this JOURNAL (Volume 20, No. 4, p. 172, April, 1929) by Love and Craig, in an item entitled "A Note on Yellow Fatuoids." From the text of this note it is clear that the authors had not read the present writer's paper and have based their statements upon Stanton and Coffman's comments and review.

Similar remarks also apply to statements made by Callaghan in the *Agricultural Gazette of New South Wales*, Vol. XL, Part 9, pp. 625-631, September, 1929.

The present note emphasizing the purport of the writer's paper, however, requires no further enlargement with reference to the comments from both these latter sources.

E. T. JONES,
The Welsh Plant Breeding Station,
University College of Wales,
Aberystwyth.

American Agents for Matsuura's Plant Genetics

The monograph by H. Matsuura (*A bibliographical monograph on plant genetics* (Genic Analysis), 1900-1925) was reviewed in the November, 1929, number of this journal but no information was given as to how to obtain copies except the place of publication, Tokyo Imperial University. Copies of the book may be obtained from the following agents: H. G. Fiedler, 89 Chambers St., New York; Dulau & Co., Ltd., 35 Old Bond St., London, W. 1; Hirschwaldsche Buchhandlung, Unter den Linden 68, Berlin N. W. 7; Maruzen Co., Ltd., Nihonbashi Tori-

Nichome, Tokyo. Prices must be obtained from these agents.

E. B. Babcock.

The American agents inform us that the retail price is $3.00 unbound; binding would cost about $1.50 additional. Some reduction could be obtained by members of the A. G. A. ordering through the Association.—*Editor.*

Parietals and Frontals in Mice—A Correction

I have just received my copy of the Journal of Heredity Volume 21, No. 1. I notice that in the article entitled "Parted Parietals" in Mice, pp. 19-20. I have made a grave error. The word "frontal" should be substituted for "parietal" throughout, as is clearly shown in the photograph.

Clyde E. Keeler.

Bussey Institution.

Lecturers on Human Behavior

I should greatly appreciate it if you could insert the following in your next issue:

"The International Congress for mental Hygiene, May 5-10, 1930, is to be attended by many foreign delegates. Some of these will be available for lecture engagements. Their interests cover a very wide range, and it is probable that a suitable speaker could be found for most any group interested in human behavior. The National Committee for Mental Hygiene will provide information about these visitors, their subjects, their possible itinerary, and availability to any organization interested. Apply to Dr. George S. Stevenson, 370 Seventh Avenue, New York."

George S. Stevenson.

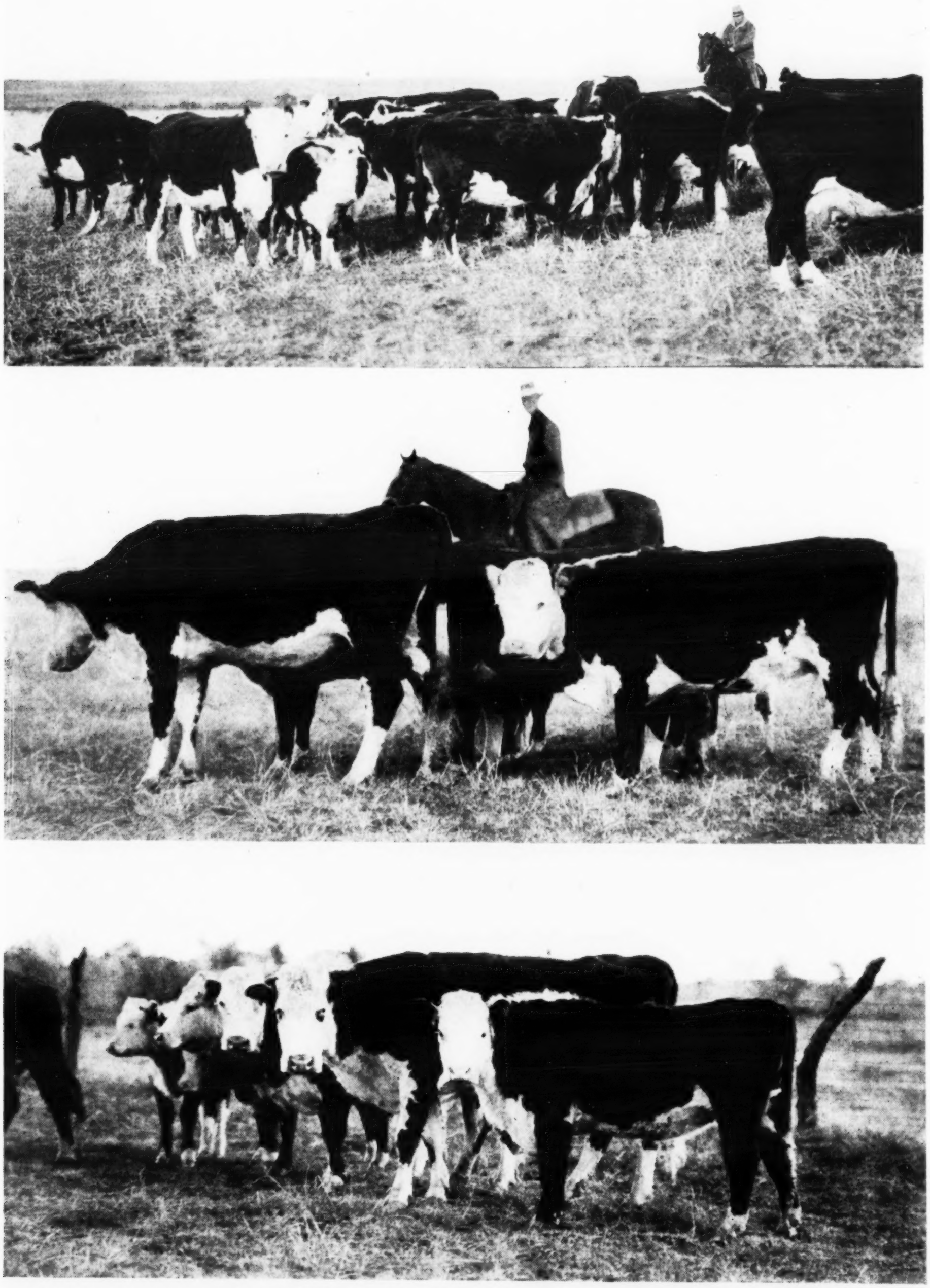
Director, Division on Community Clinics, National Committee for Mental Hygiene.

Sir Francis Galton

THE picture of Galton reproduced on the cover is from the painting by C. W. Furze, A. R. A., made about 1900. The original is in the Galton Laboratory at the University of London.

Galton is most widely known as the founder of the Eugenics Movement, and to this subject he gave much time in the later years of his life. Exploration, meteorology, statistics, anthropology were some of the subjects to which he made important contributions, and a host of other problems attracted his attention (in 1872 he published a paper on "Statistical inquiries into the Efficacy of Prayer"). A cousin of Charles Darwin, he could write authoritatively on "Hereditary Genius"!

We are informed by Mrs. C. B. S. Hodson of the Eugenics Education Society that the instrument on which Galton's left hand rests in the picture is a microscope invented by him for studying fingerprints. It is still in use at the laboratory which he founded for the study of Eugenics at the University of London.



DUCK-LEG AND NORMAL CATTLE

Figure 15

Three views of duck-leg cattle on Parramore ranch south of Guthrie, Texas. Normal cows in each picture show the contrast in length of leg. The other proportions of the duck-legs are apparently not much changed—they are simply normal cattle about four to six inches closer to the ground.

"DUCK-LEGGED" CATTLE ON TEXAS RANCHES

JAY L. LUSH

Texas Agricultural Experiment Station

AN extremely short-legged calf was shown at the Southwestern Livestock Show and Exposition at Fort Worth in March, 1927 in one of the beef calf classes open to club boys. Inquiry of the boy who showed the calf gave information which suggested that this very distinct short-leggedness was hereditary.

Further inquiry, including trips to ranches and letters from men who grew up with the cattle industry in extreme south Texas and in central west Texas revealed a clear-cut family history of the trait, its similar genetic behavior in widely separated herds, and a probability that it is inherited as a simple Mendelian dominant. It is probable that the Texas "duck-legs" all trace back to a single origin or importation of the trait now widely scattered; possibly it may be identical with the short-leggedness of the black Dexter cattle of Ireland. A feature of especial interest is its transference, from the original cattle in which it appeared, to grade Hereford cattle many of which are scarcely distinguishable from purebred Herefords except for this shortness of leg. The story is of sufficient interest to justify its presentation although opportunity did not occur to make critical matings which would verify beyond doubt the mono-factorial basis of the trait nor to test its genetic identity with the short-leggedness of the Dexters.

Outward Appearance of "Duck-Legs"

The calf seen at the Fort Worth show weighed 540 pounds when sold, measured 16 inches from the ground to the floor of his chest, and the top of his withers was 37½ inches above the ground. This compares with an average of 20½ inches and 42.4 inches for 23 normal Hereford calves fattened in the experimental feedlots of the Texas Station at Spur during the same winter and the preceding winter. The Station calves averaged 648 pounds at the close of the feeding period, but this feedlot weight should probably be shrunk 30 to 50 pounds so as to be comparable with the condition of the short-legged calf when sold at Fort Worth. Possibly the Station calves were slightly older. Chest depth constituted 57.3% of the wither height of the short-legged calf but only 51.5% of the wither height of the normal calves, thus corroborating the testimony of the eyes that the trait was primarily a case of short legs and not dwarfness of all parts of the body. No other short-legged animals were measured but the pictures show the same short-leggedness with bodies of normal size in animals seen on the range. Mature short-legged cows seemed to differ from normal ones only in that their bodies were about four to six inches nearer to the ground. So far as could be observed all the bones of the legs shared proportionately in this shortness. Careful watch was kept for enlarged joints, bull-dog heads or other signs of abnormal bone deposition indicating thyroid[2] under-functioning but nothing of that kind was seen. The bodies may perhaps have been a bit shorter than those of normal cattle but in the absence of a series of measurements one can hardly be sure of that because the marked shortness of the legs disturbs the basis for visual comparison. The heads seemed quite as long as those of normal cattle, a point which was carefully scrutinized in all cases. The short-legged cattle may have been a little fatter than the normal ones in the same pas-

tures. The writer believes that there was a small but real difference in this respect. Here again there was no objective way of measuring the character observed. The writer may have been unduly influenced by the statements made by some of the men handling these cattle that the "duck-legged" ones were always among the fattest and most thrifty in their pastures.

Examination of Glands

The calf shown at Fort Worth was slaughtered immediately after the show in the plant of Swift and Company and six of the glands of internal secretion were secured for weighing and sectioning. They were placed in 50% alcohol solution about two o'clock one afternoon, brought to College Station that night, weighed the next morning, and preparations for making sections of them were begun immediately. After samples were removed for sectioning, other samples were air-dried at 180° to 212° F. in a conditioning oven. From the percentages of loss in drying, the air-dry weights of the original glands were calculated. The results were as follows:

Name of gland	*Fresh weight (grams)*	*Air-dry weight (grams)*
Thyroid	15.00	8.02
Thymus	527.00	143.87
Parathyroids	.51	.22
Pineal	.16	not obtained
Suprarenals	12.20	3.69
Pituitary	1.96	.50

The large thymus probably reflects only the youth of the calf. The thyroid, parathyroids, and suprarenals are quite within the normal range of weights for these glands. The pineal body seems to be about normal or perhaps a little small. The pituitary seems to be unusually small although the standards* available are meager and the limits of variation have not been well studied. Dr. Calloway, then in charge of the Bureau of Animal Industry inspection of Swift and Company's Fort Worth plant, personally made a macroscopic examination of these glands as the steer was slaughtered. He found nothing abnormal except that the pituitary seemed unusually small.

Sections of each of these six glands were prepared for histological study†, but all seemed to be normal or at least not distinctly enough abnormal to be recorded as such. The results of the examination of the glands may be summed up by saying that no distinct abnormality was found except the small size of the pituitary. Craft found small pituitaries and also very small thyroids in his cretins although inclined to place more emphasis on the condition of the thyroids as the immediate cause of the abnormality. Crew[3] and Adametz[1] in extensive studies of dwarfness in the Dexter cattle and in the Tux-Zillertal cattle have come to the conclusion that the defective thyroid is a secondary consequence of early mal-functioning of the pituitary. Have we in these "duck-legged" cattle of Texas genetic and physiological identity with the less extreme degrees of dwarfness among the Dexters and Tux-Zillertals?

History of Texas Herds

These cattle are commonly called "duck-legs" or more rarely "Tuck-

*(1) Information to the writer from Dr. C. Robert Moulton, Institute of American Meat Packers.

(2) Yield and value card for "fancy meats" dated May 24, 1926, and then in use in the plants of Swift & Company.

(3) Data to the writer from Professor W. A. Craft, Oklahoma Agricultural and Mechanical College, giving 3.3, 3.4, and 3.6 grams for the fresh weights of the pituitaries from three 8 to 10 months old normal steers and 1.9 and 2.1 grams for the weights of the pituitaries from two "cretin" steers.

†By Dr. J. D. Jones of the Veterinary Science Division of the Texas Agricultural Experiment Station.

apaw" cattle. The former name is descriptive, the latter is connected with one version of their history according to which the first cattle of the kind were two black heifers with white spots on them brought by Col. J. H. Parramore from Tuckapaw parish in Louisiana to Runnels County, Texas, in 1879 or a few years later. (The word is spelled as pronounced and has been handed down orally for many years. The nearest approach to it among the present parishes of Louisiana is Tangipahoa).

Another account by L. P. Woods of Ballinger who accompanied Col. Parramore west in 1879 is that the Parramore duck-legs were obtained near Gonzales, Texas, where they or their parents had been brought from the Kenedy ranch in Willacy County in extreme south Texas. A few Kerry cattle had been imported direct from Ireland to the Kenedy ranch in the early seventies.

However, Mr. John G. Kenedy of the Kenedy ranch writes that the first he saw were in 1884 or 1885 in a herd which they pastured for another man. They bought some of these and bred a few of them for many years. He mentions several people who bred them at one time or another in south Texas. Mr. Pat Dunn, the owner of Padre Island, bred them for many years and sold breeding stock to a number of others. Mr. Kenedy mentions their marked resemblance to the Kerry cattle of Ireland but does not know of any direct importation.

Another less specific account is that they were brought from France by early settlers along the coast country of Texas south and east of Gonzales.

One of Col. Parramore's sons purchased a Dexter bull from the Busch farm near St. Louis in 1920 and the men who saw this bull and his get were impressed by the resemblance between them and the "duck-legs" which they had been breeding for twenty years and more. Whether this bull or his descendants were bred on the "duck-legs" is not certain but seems quite likely in view of the cattleman's natural tendency to experiment freely with cross-breeding the strains which look desirable to him.

System of Breeding "Duck-Legs" In Range Herds

When Col. Parramore went to Runnels County the modern beef breeds had hardly begun to find their way to the ranches. The customary practice was to save for breeding likely-looking, growthy bull calves of the rancher's own raising with little or no attention to color. Many duck-leg bulls were saved as they were naturally fat and thrifty. When improvement with the modern beef breeds began there were many of the duck-leg cows left and these of course produced many duck-leg daughters which were kept. Thus the number of duck-legs in the herd diminished but slowly while several generations of purebred Hereford bulls were being used. However, the duck-leg cows of later generations carried more and more Hereford blood and eventually came to be almost indistinguishible from pure Herefords except for their shortness of leg.

Of course the duck-legs would have disappeared altogether eventually if there had been no selection in their favor. But many Texas ranchmen have a fondness for keeping odd and unusual bits of animal life about them, especially if these are varieties in the creation of which they have had a share. Consequently when the duck-leg cows grew scarce some of these men gathered a small herd of duck-leg cows and kept them where they could be seen from time to time. Whenever the number of these grew so small as to threaten the extinction of the strain, a good-looking duck-leg bull would be saved and used for two or three years on a small herd of choice normal cows and the duck-leg heifers from this breeding would be added to the duck-leg herd until it was large enough that there was little danger of losing the strain. Then the duck-leg bull (a grade of course) would be sold

HEREFORDS IN ALL CHARACTERISTICS BUT LENGTH OF LEG

Figure 16

Normal cow and duck-leg on the ranch of J. P. Maddox, Maryneal, Texas. The duck-legs in Texas date from about 1880 or before; their genetic identity with short-legged Dexter-Kerry cattle of Ireland is problematic. In any event the transfer of the duck-leg character to a strain unchanged in other respects is a feat that has rarely been accomplished with farm animals.

and for several years only pure Hereford bulls would be used on the ranch until the herd of duck-legs cows again grew small and another duck-leg bull had to be saved. The process therefore was a steady infusion of Hereford blood with little inbreeding of related duck-legs and with selection placing a high value on the shortness of leg but not on any other characteristic peculiar to the original duck-leg strain. The result is that the duck-leggedness has been transplanted, as it were, into an otherwise pure Hereford strain, — a thing which is easy enough to plan on paper where a simple Mendelian dominant is concerned but which has rarely been accomplished with farm animals. It is also interesting to note that this happened in herds managed by men who did not know of Mendel's laws— indeed it was well on the way to accomplishment before the scientific world learned of those laws. The final step in the transfer of duck-leggedness to a Hereford strain, that is, the making of that strain homozygous for the factors which govern duck-leggedness, has not been taken nor is it likely that it will be taken. The duck-legged Herefords are still grades, of course, and the men who keep them do so more for sentimental than for economic reasons although every one mentions their easy-keeping qualities. Consequently they use pure Hereford bulls except when it is occasionally necessary to use a grade duck-leg bull a short while to keep up the numbers in the strain. Not all of the breeding has been as systematic as this and duck-legs which are black or other off-colors are still to be seen. Normal black or off-colored cattle are also to be seen in those same herds, however, and nothing has been seen to indicate that there

is any connection between color and duck-leggedness except that according to all accounts the first duck-legs were largely black.

Mode of Inheritance

The system of breeding to perpetuate the duck-leg strain by itself shows that the character is dominant. Also those men who have bred duck-legs together are unanimous in saying that not all calves from such matings are duck-legs. Some will have legs perfectly normal in length. Duck-legs bred to normal unrelated cattle will produce a large percentage of duck-leg calves. We have no careful counts of these on which to calculate the ratios but these facts are just what would be expected if the characteristic were a simple dominant, and would be difficult to explain if it were recessive.

The duck-legs are distinct from normal cattle. There are few if any intermediates about which a cattleman would be in doubt as to whether they were unusually long-legged duck-legs or unusually short-legged normal cattle. Even a novice riding up to a strange herd would probably have no difficulty in classifying nine-tenths of them although he might confuse a few large-bodied normal young cows with older duck-legs.

That the characteristic can be produced by a single factor seems inherently necessary to explain how it could be preserved under a long-continued system of out-crossing away from it. Had two or more complementary factors been necessary for its development, the proportion of duck-legs produced under this out-crossing system could hardly have been as large as it was. Range calf crops in this region probably do not average quite 70%. Half of these will be males. On a monofactorial basis we would expect half of the females to be normal. For replacement there would be available only about 17 duck-leg heifers each year for each 100 duck-leg cows bred. This would require duck-leg cows to be kept in the breeding herd an average of six years in order to maintain the numbers even if all duck-leg heifers were saved and lived to breeding age. If two complementary factors were involved, one could expect only about 8 duck-leg heifers per year per 100 duck-leg cows of breeding age, and this would hardly have sufficed to maintain the duck-leg strain as easily as was done under this system of almost continuous out-crossing.

Against the hypothesis of simple dominance should be placed the experience of Mr. Kenedy: "We do not breed them any more but now and then some of our cows throw a duck-leg." Also a son of Col. Parramore, Mr. D. D. Parramore of Abilene, is of the opinion that the long legged daughters of duck-leg bulls will often have duck-leg calves. These observations would seem to indicate that dominance is occasionally imperfect or obscured by some other combination of factors or circumstances. It should be remembered, however, that these are large ranches usually with several bulls in each pasture and that when a change of breeding stock or policy is undertaken, it is often several years before the pastures are finally cleared of the original stock. A calf's dam is almost always known correctly up to weaning time but of his sire there is usually nothing known except, perhaps, that he must have been one among a certain group.

Resemblance to Dexter-Kerry Dwarfness

Is this genetically identical with the Dexter-Kerry dwarfness? The critical tests to answer this (matings of them with the Dexters) were not made or if made were not recorded. Externally and in manner of inheritance the known facts correspond very closely to the situation with the less extreme types of Dexters. No "bull-dog calves" or extreme dwarfs, which are common where Dexters are bred together, were reported from these Texas herds although careful inquiry on this point was made in all interviews. Crew postulates in the Dexters one main factor

(dominant) for dwarfness and two independent (dominant) modifying factors which intensify that dwarfness. The presence of all three factors is lethal, producing the "bull-dog" calf. The Texas cases behave about as would be expected if the fundamental factor for Dexter dwarfness were present but without either modifying factor. The method of continued out-crossing would have led to this result if the original Texas duck-legs really were Dexters, whether or not the modifying factors were also present at that time.

It may not be amiss to call attention again to the probable rôle played by glands in this truly hereditary abnormality. If an under-functioning of the pituitary be the immediate physiological cause of this dwarfness, yet it is just as truly hereditary as if we knew nothing about its physiology,—the family history of the case proves its heritability. The part played by the pituitary (if substantiated) merely changes the problem from the inheritance of a general abnormal development of the legs(and possibly other parts of the body?) to the inheritance of an abnormal condition of the pituitary. Doubtless if we knew more about the embryology and early physiology of the pituitary gland in dwarfs and in normal cattle we could push the problem further back to a still simpler statement. Differences in the functioning of the glands must themselves have had causes and of those causes some no doubt are genetic differences in the original fertilized eggs while others are environmental forces acting upon the embryo in its early development. To state the problem as "glands versus heredity" is only confusing. It is more correctly stated as: environment and heredity, each acting in part—perhaps a large part—through the endocrine glands as intermediate parts of the physiological mechanism.

Summary

1. A case of hereditary short-leggedness in cattle on several Texas ranches is reported.

2. Its hereditary behavior corresponds closely to the hypothesis that it is the result of a single dominant gene inherited in simple Mendelian manner.

3. Physical examination points to an under-functioning of the pituitary body as the immediate cause of this dwarfness.

4. The appearance and manner of inheritance as well as the incomplete history of its introduction to Texas indicate that this abnormality may be identical with the less extreme forms of dwarfness in the Dexter-Kerry cattle of Ireland.

5. In some herds a continued system of out-crossing to purebred Hereford bulls accompanied by selection of the short-legged females and the occasional use of a grade short-legged bull to replenish the numbers of short-legged females in the herds has led to the production of animals which cannot be distinguished from pure Herefords except by this short-leggedness.

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ABNORMALITIES IN PECANS*

II. Abnormalities in Pecan Nuts

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A CLUSTER OF SEVENTEEN PECAN NUTS

Figure 17

Less than a half dozen clusters of pecans this large are on record. It is not abnormal but the flowers and nuts in the earlier stages of development merely failed to drop as is usually the case. Every flower-cluster of pecans has potentialities of producing ten to twenty nuts, but ordinarily only one or two grow to maturity. Teche variety.

NATURAL classifictions of higher plants are based almost entirely on flowers and fruits, these being considered the most fundamental and characteristic parts of plants and least subject to environmental changes.

In a preceding paper[1] it was pointed out that the flowering habit of the pecan seemed somewhat unstable. In the present paper it is pointed out that the fruiting habit of the pecan is also subject to considerable variation.

Stems, leaves, flowers and fruit of the pecan show it to belong to the Dicotyledones (plants having two cotyledons or seed leaves). The normal characteristics of the fruit are as follows: The FRUIT has a dry, firm, brittle, woody, inedible, four-valved exocarp (involucre, hull or shuck), which at maturity falls away from the smooth, hard, crustaceous, thin, brittle, inedible endocarp (shell of the nut). The NUT is one-seeded indehiscent, ovoid to ob-

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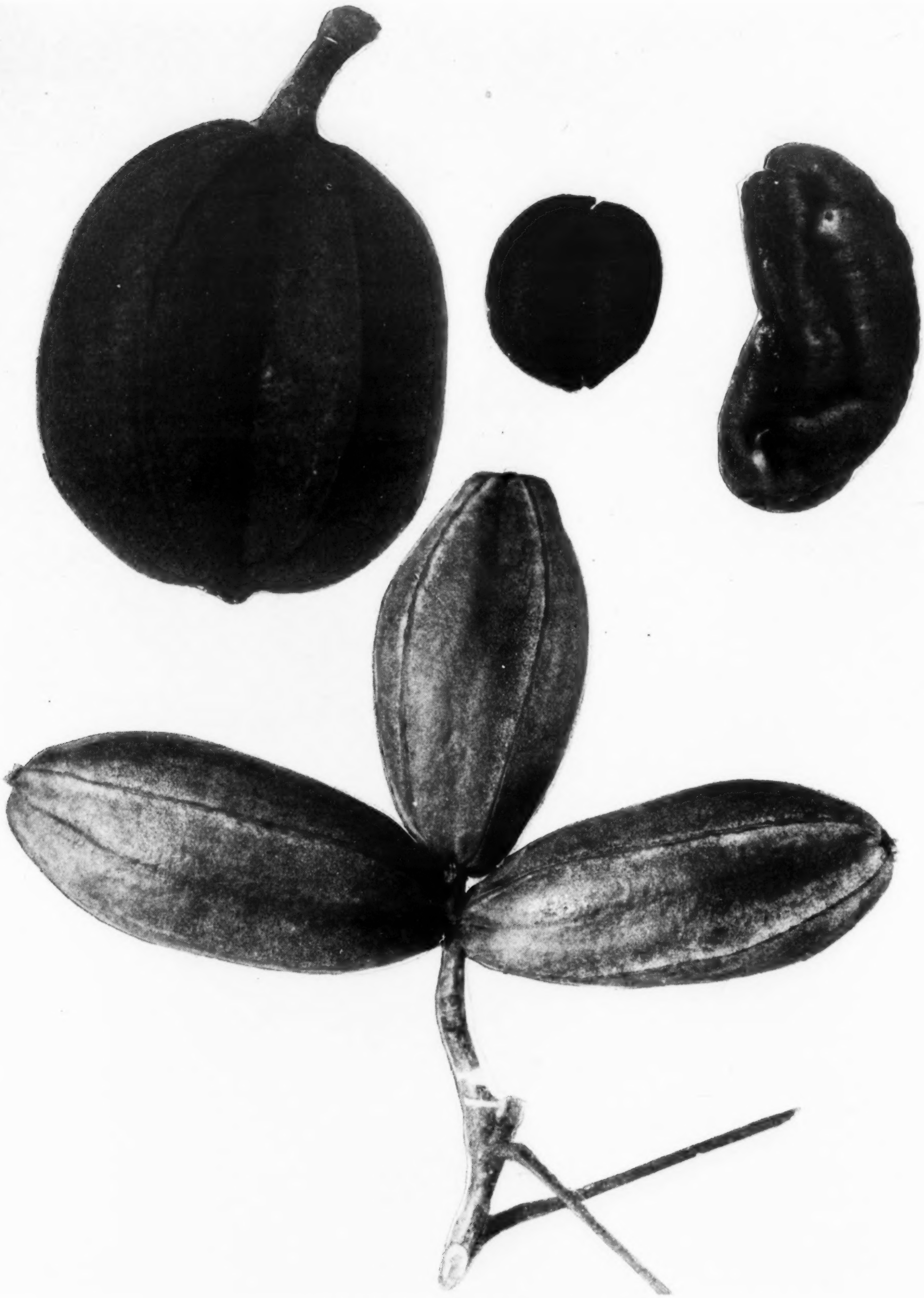
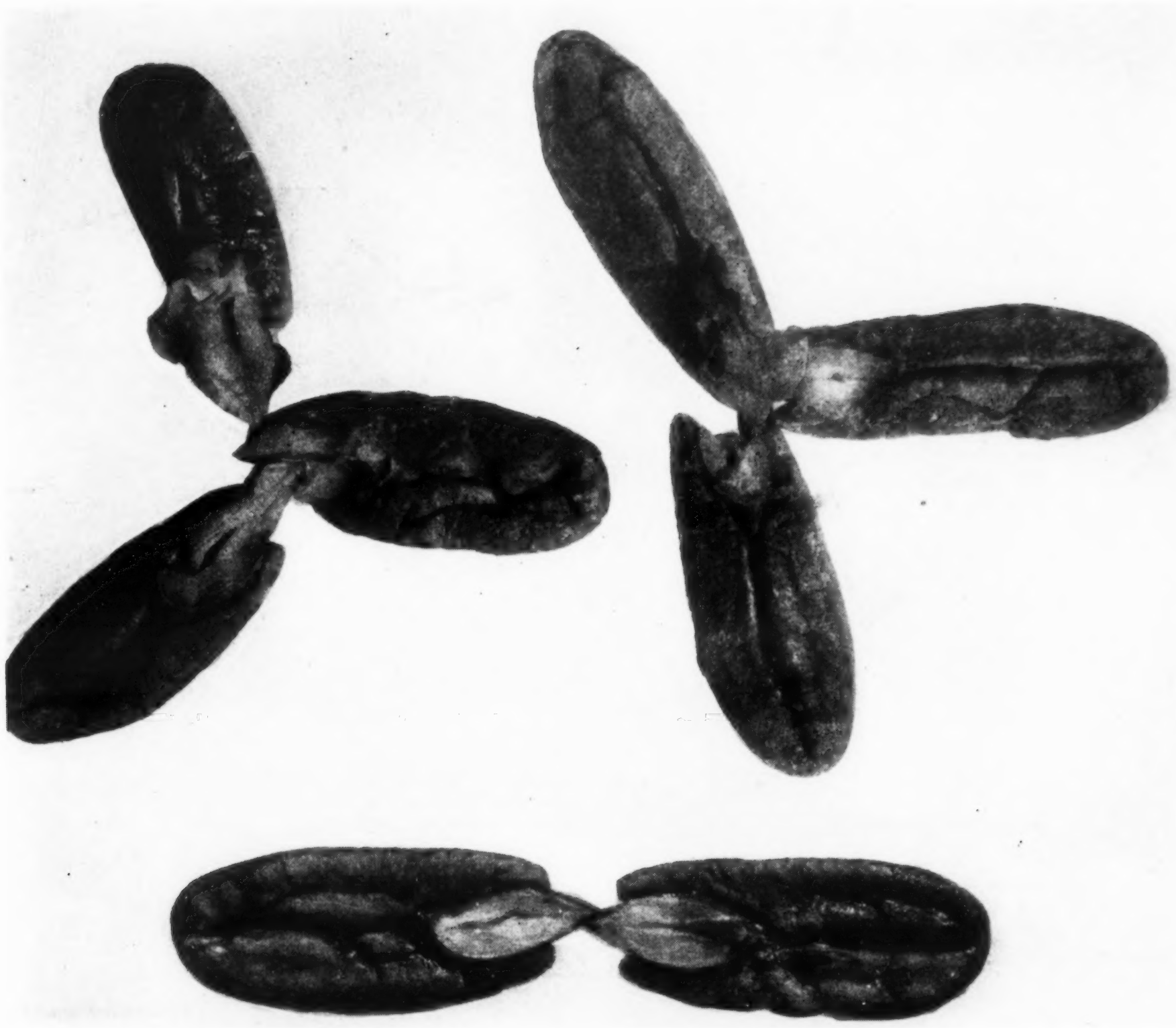


TWINNING OF PECAN NUTS

Figure 18

Top row: A twin nut showing exterior of the hull before harvesting (left), a reduced view of the nuts after the hull was removed; an embryo from one of the nuts (right). The hull, shell and embryo were abnormal. Below, a normal cluster of three nuts of the Mobile variety.



"TRIPLET" AND NORMAL PECAN EMBRYOS

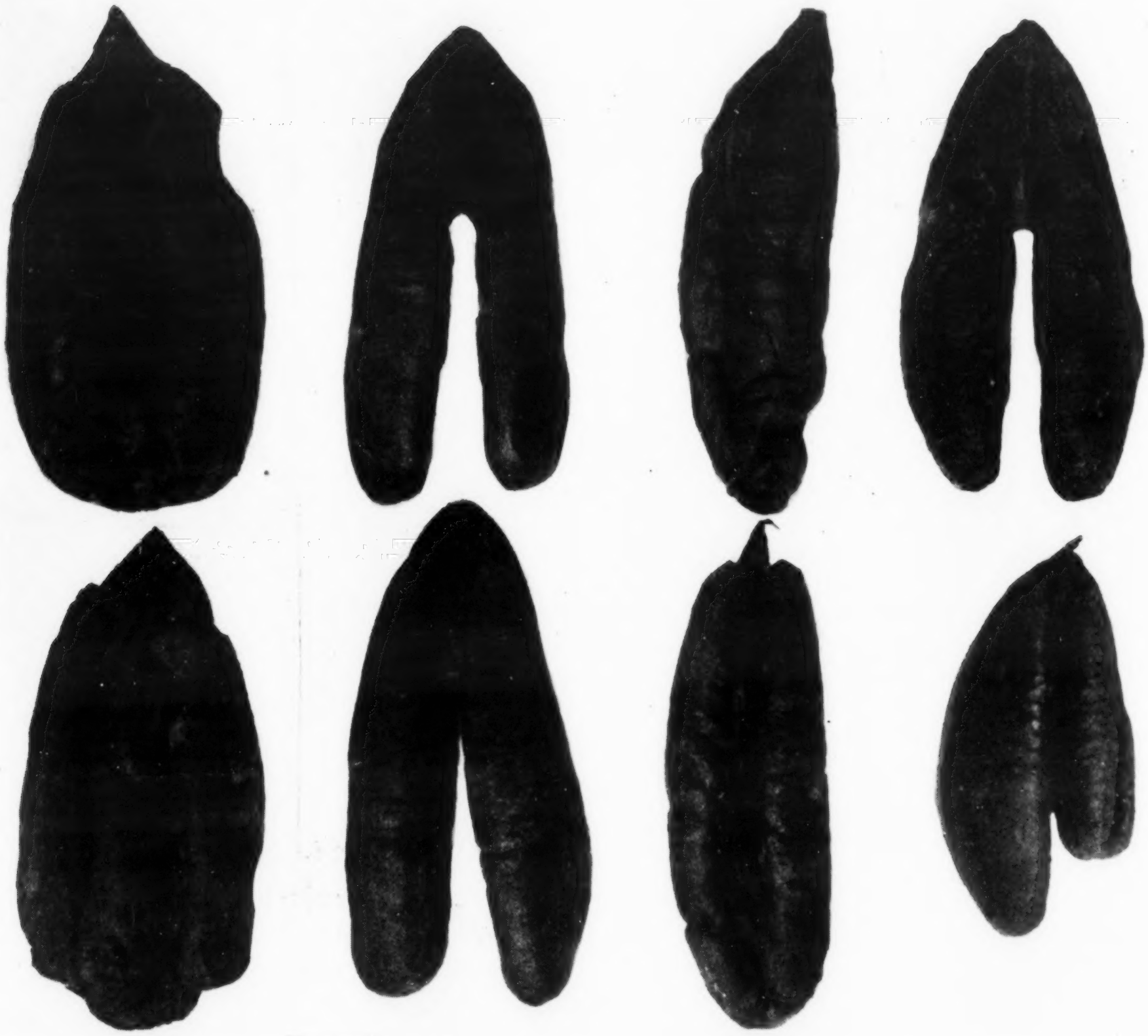
Figure 19

Two abnormal embryos broken open to show the three cotyledons; and a normal embryo broken open to show the two cotyledons. All the triplet embryos found have been in the Atlanta variety, suggesting a genetic cause for this variation.

long and somewhat cylindrical, pointed at the apex and round to pointed at the base; stutures divide it longitudinally into halves; color dull grayish brown overlaid with numerous black markings.[2] The SEED (embryo) is the sweet, edible portion which is enclosed within a thin, delicate, reddish-tan seed coat. The nearly flat cotyledons are double grooved from near the base to the apex.

Several types of abnormalities have been observed in the fruit of pecans.

(A) The greatest departure from the normal habit of development was found in the seed or embryo. Embryos with three cotyledons have been found in the Atlanta variety for several successive years; while none have been found in thirty other varieties grown in the same orchard. This variety is not grown commercially and nuts of it have not been examined from other sections. In 1928 embryos were carefully removed from more than a thousand nuts of the Atlanta variety. Examination showed that five-tenths of one per cent of the embryos had three cotyledons, and that twenty-five-hundredths of one per cent of the embryos had only one cotyledon (see Figures 20 and 21). From five to ten per cent of the embryos had cotyledons in various stages of abortion.



ABNORMALITIES IN PECAN EMBRYOS

Figure 20

Reading from the left: Two embryos with three cotyledons each; two normal embryos with two cotyledons each; two embryos with one cotyledon each; two embryos with misshaped cotyledons (Right). No external marks on the shell indicate whether a pecan nut contains one, two, or three cotyledons.

Between the extremes of one cotyledon on one hand and three cotyledons on the other, various types of gradations were found. Embryos with one cotyledon had a double groove on one side extending from apex to base in a normal manner, while the other side was twisted and shrunken. Some embryos had one cotyledon, as described, but they had a "bump" or vestige of a second cotyledon which failed to develop. Others had one normally developed cotyledon, and some appeared normal except for being only half the normal length.

Embryos with three cotyledons had the double groove along the outermost side of each cotyledon, as did embryos with only one cotyledon. The inner surface consisted of two faces forming an angle of about 120 degrees rather than a flat face as in the case of embryos with two cotyledons. Some embryos had two almost normal cotyledons and a "bump" or vestige of a third cotyledon which failed to develop.

Due to the small number of embryos with only one or with three cotyledons, early stages of the development have not been studied; but studies of mature

"HAPLOID" AND "TRIPLOID" PECAN EMBRYOS

Figure 21

Above: Three embryos with only one cotyledon each. Below: Three embryos with three cotyledons each. Both forms are rare, but the single embryo occurs only about a quarter as often as the triploid form.

specimens indicate that the presence of only one cotyledon at maturity is not a result of merging of two cotyledons into one, but rather the result of a failure of more than one cotyledon to differentiate or develop in the region of the hypocotyl. The presence of a third cotyledon in an embryo does not appear to be the result of branching of one of the existing cotyledons, but an independent growth from the region of the hypocotyl.

No external marks on the shell indicate that the enclosed embryo contained one, two, or three cotyledons.

(B) Less than one per cent of the nuts in lots of the Stuart variety examined have been found with the shell or endocarp divided into three parts. Nuts thus divided germinated normally but were considered abnormal due to the extra suture in the shell. The Stuart is the most extensively planted variety in southeastern United States, but the few abnormal specimens found have not afforded sufficient material for thorough study. It would seem that a relation should exist between three sutures in the shell and three cotyledons in the embryo, but the number of cases observed do not afford proof of the assumption.

There are normally four sutures and four sections in the exocarp or husk of pecans. Five or six divisions are quite common, but this variation is considered one of degree rather than one of kind and is not considered abnormal.

(C) A third type of abnormality observed in pecans is designated as twinning. Twin nuts seem no more subject to premature dropping than single nuts, and often remain on the tree until mature. Of the thirty varieties under study at the Georgia Experiment Station, the Curtis seems most susceptible to twinning, but other thin shell varieties, as Schley, San Saba, and Atlanta, occasionally show tendencies towards twinning. The phenomenon has not been observel in thick shelled varieties, as the Rome, Nelson and Success.

In twin nuts all of their parts are involved. Sections of the hull of each nut develop normally while other sections grow together to some extent. Usually a thin layer of hull material is between the shell of the two nuts, but sometimes the shells of the two are merely in contact and do not grow together. When the shells are in contact the apexes and bases of the nuts are influenced in such a way as to cause each nut to develop in the shape of a semi circle. The embryos are also one-sided, to conform to the shape of the shell. One cotyledon may be almost normal with the other cotyledon much reduced in size, or both cotyledons may be twisted and reduced in size.

Twin nuts are just as apt to be well filled as other nuts on the same tree, but in harvesting the nuts are broken apart and due to the shape of the shell and embryo, they are classified as low grade or faulty nuts.

The number of nuts per cluster to mature differs with varieties and may range from one to seven. Clusters of more than eight nuts are extremely rare but they are not considered abnormal because, as has been previously reported[3], until dropping of flowers and nuts occurs, each cluster has potentialities of producing from ten to twenty or more nuts. Thus variation in the number of nuts per cluster is one of degree rather than of kind.

Summary

Though the pecan is dicotyledonous, embyros were found which contained one, two, or three cotyledons. Those having one or three cotyledons are abnormal. The endocarp normally has two sutures; nuts containing three sutures were found and are considered abnormal. Twin nuts occur sometimes and are objectionable due to the abnormal shape of both the embryo and shell.

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